



# Test Report

High Temperature Monitoring Test  
for Automotive Backlites

06.08. - 30.08.2010 in Seville, Spain

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## **1. Test conditions**

Four test vehicles with a hatchback are parked in Seville, Spain facing south with their backlite. They are directly exposed to solar radiation with no obstruction between sun and vehicle. The tested vehicles are:

VW Eos

Skoda Octavia

Audi TT

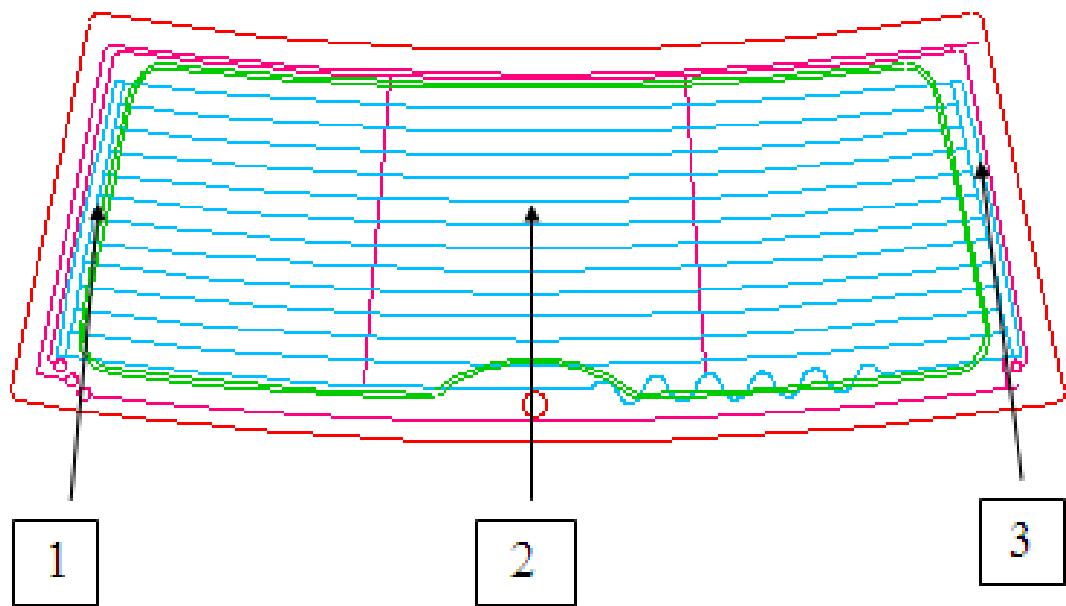
Peugeot 407

A preciser description of the cars follows in the next chapter.

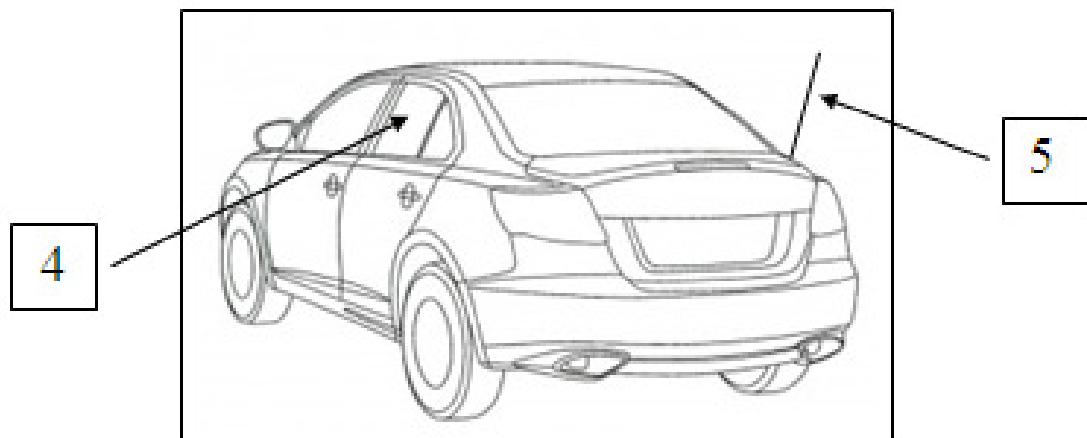
In each car 5 temperature sensors are installed at following places:

1. Passenger side heatgrid terminal
2. Center of glass
3. Driver side heatgrid terminal
4. Ambient temperature inside vehicle (backseat)
5. Ambient temperature outside vehicle (feed through hatch)

Figure 1 shows the positioning of the sensors.



**Figure 1: Sensor positions 1**



**Figure 2: Sensor positions 2**

Every 5 minutes the temperature of the sensors and time is recorded and saved. The total test duration for each car is 2 weeks. Every day the test administrator has to download the data from the measuring equipment. Before downloading the data the administrator needs to turn on the heated defrost in the vehicle for two complete cycles. The time when the first cycle starts has to be noted. This should as close to 2pm as possible.

## 2. Test assembly

### a. Tested cars

In the following chapter all tested cars are listed including information about year of manufacture and details about the backlite. The sensors at the backlite are taped with Kapton polyimide to keep them in position.

#### i. VW Eos



**Figure 3: VW Eos Convertible**

VW Eos Convertible

Year of manufacture: 2009

Angle backlight: 65,6° to vertical

Glass thickness: 3,15mm

Light transmission: 73,5 ±1,5%



Figure 4: VW Eos Convertible - Backlite details



Figure 5: VW Eos Convertible - Sensor positioning

## ii. Skoda Octavia



Figure 6: Skoda Octavia wagon

Skoda Octavia wagon

Year of manufacture: 2000

Angle backlight: 55° to vertical

Light transmission: Green Glass



Figure 7: Skoda Octavia wagon - Backlite details



Figure 8: Skoda Octavia wagon - Sensor positioning

### iii. Audi TT



**Figure 9: Audi TT Coupé**

Audi TT Coupé

Year of manufacture: 2009

Angle backlight: 70° to vertical

Glass thickness: 3,2mm

Light transmission: Green Glass SGN



Figure 10: Audi TT Coupé - Backlite details



Figure 11: Audi TT Coupé - Sensor positioning

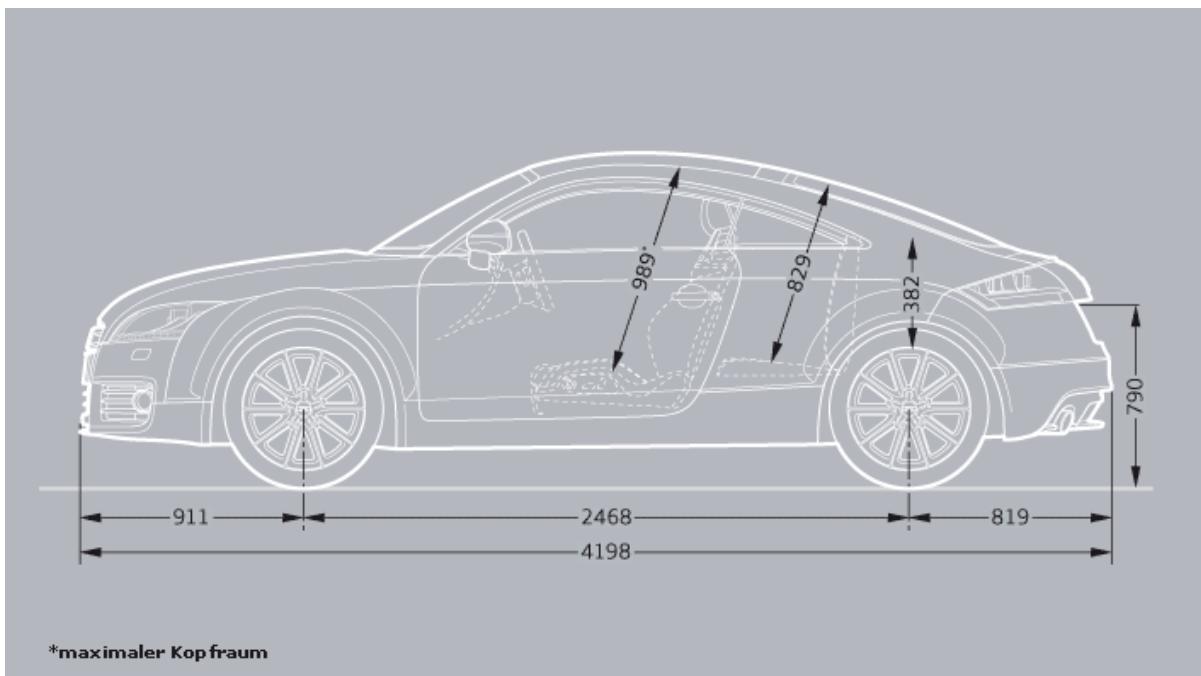


Figure 12: Audi TT Coupé – Side

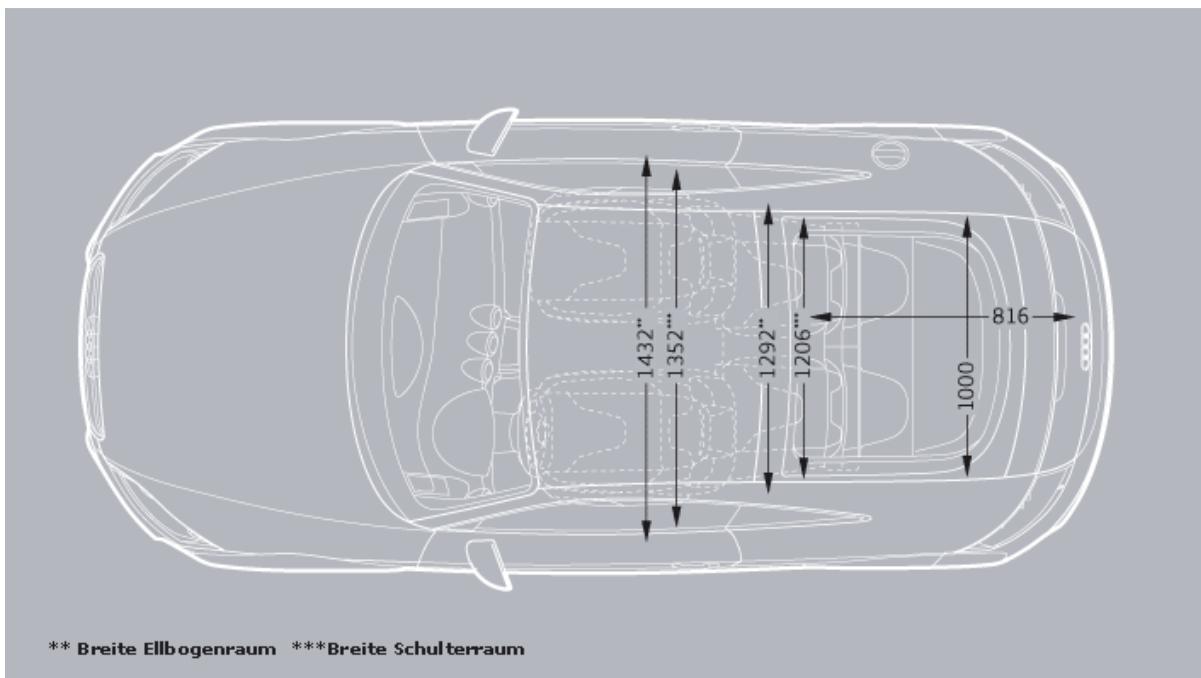


Figure 13: Audi TT Coupé – Top

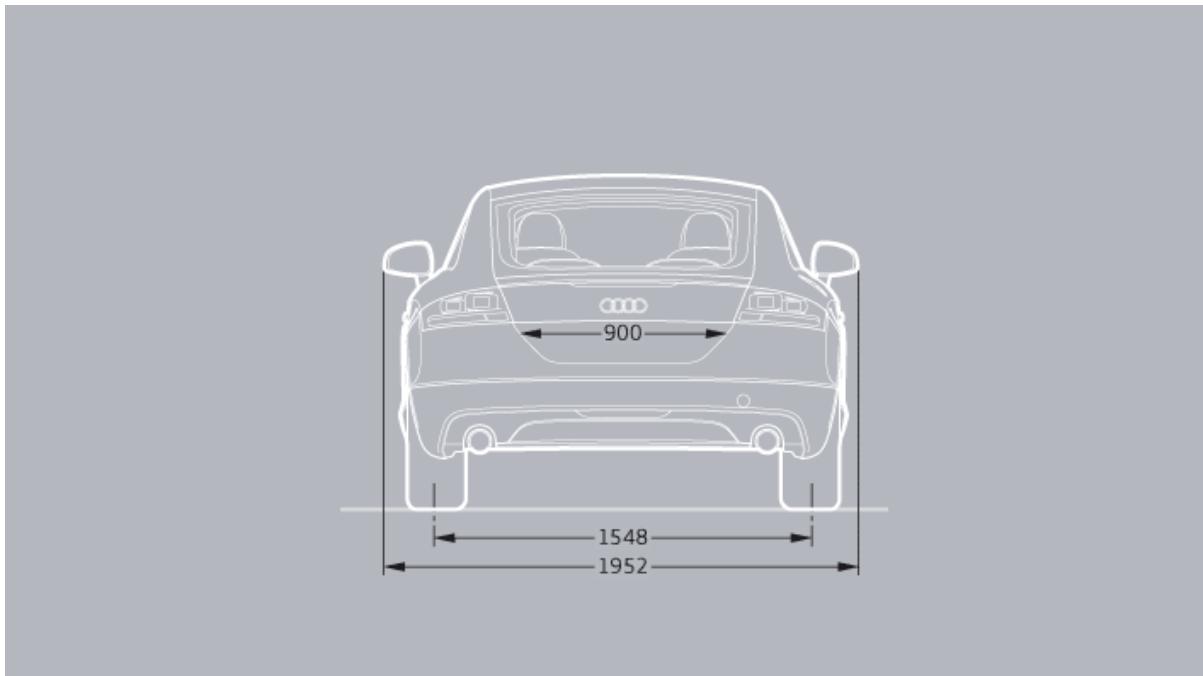


Figure 14: Audi TT Coupé - Back

#### iv. Peugeot 407



Figure 15: Peugeot 407 Coupé

Peugeot 407 Coupé

Year of manufacture: 2009

Angle backlight: 65,5° to vertical

Glass thickness: 3,85mm

Light transmission: 71% ±1,5%



Figure 16: Peugeot 407 Coupé - Backlite details



Figure 17: Peugeot 407 Coupé - Sensor positioning

### 3. Measured Data

#### a. Measured temperature for every single car

##### i. VW Eos

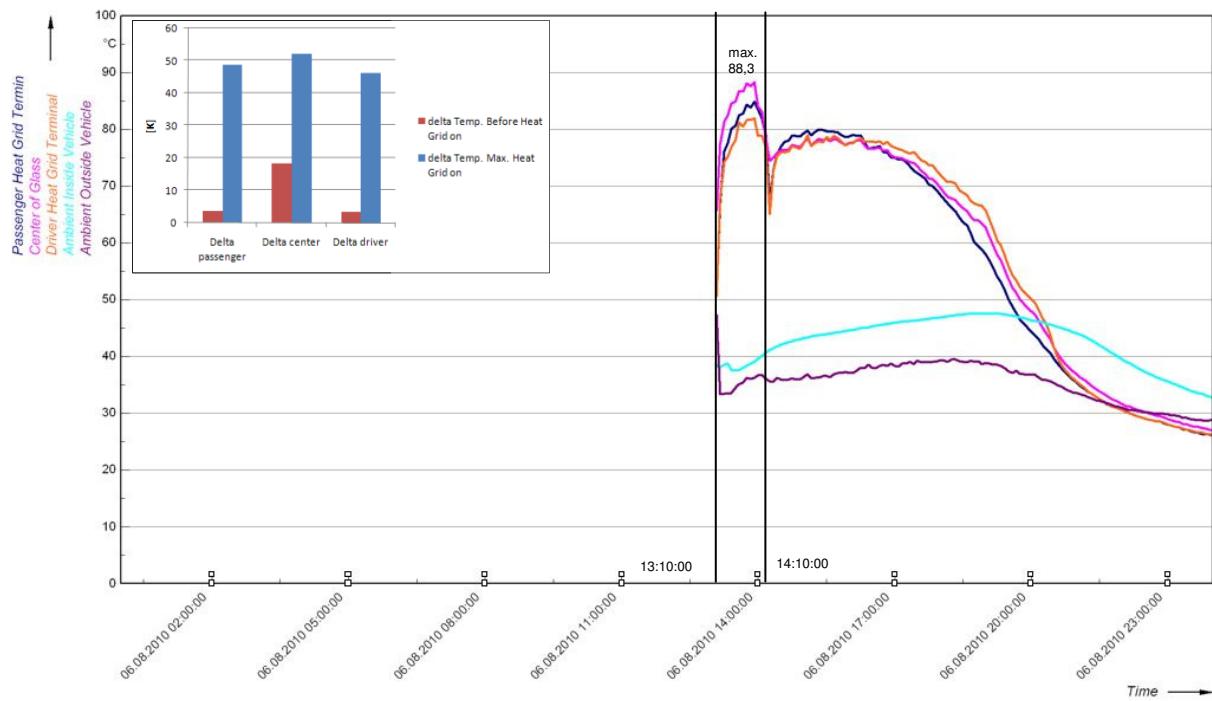


Figure 18: VW Eos - 06.08.2010

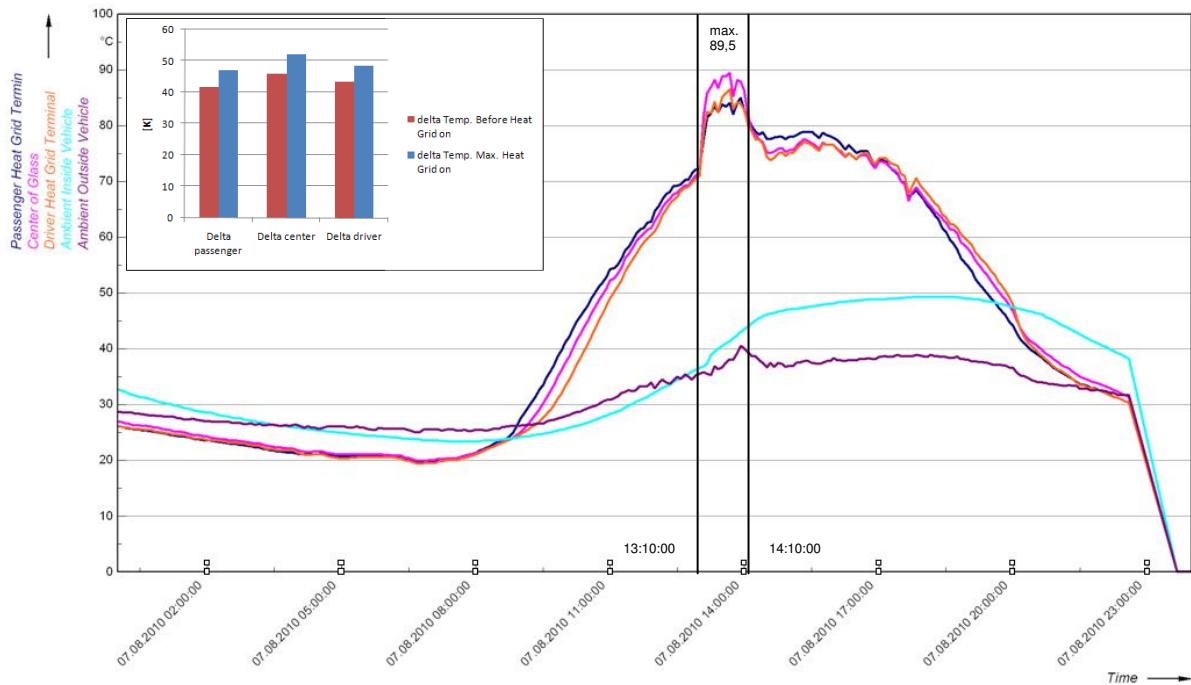
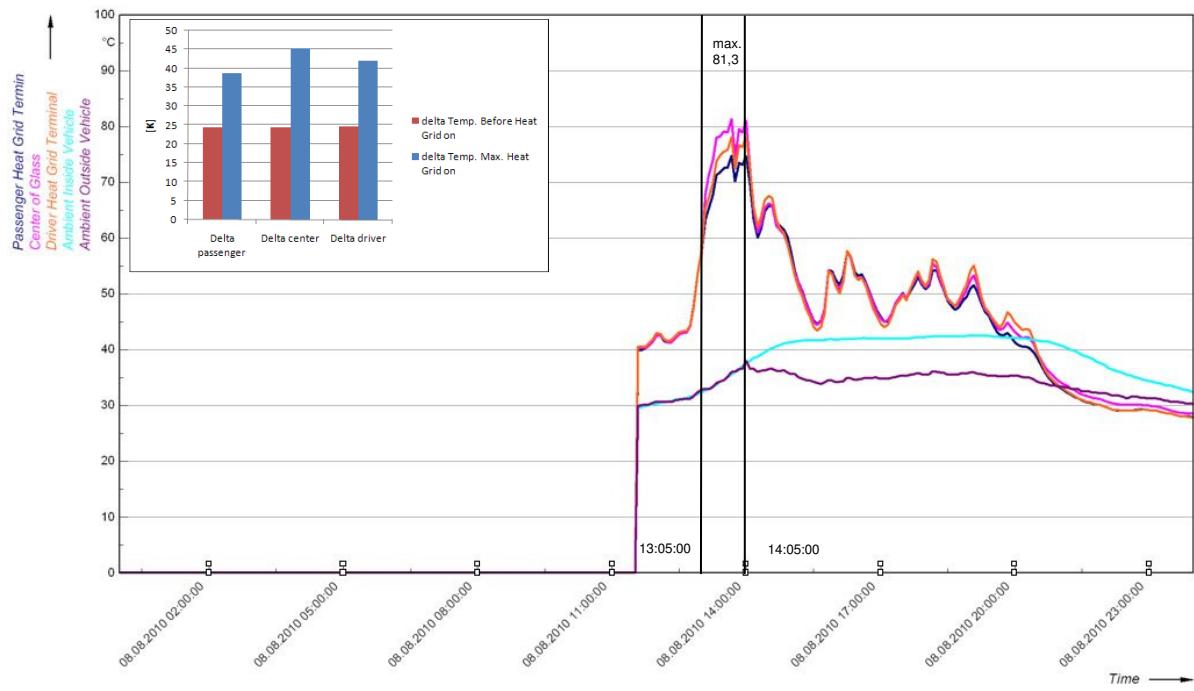
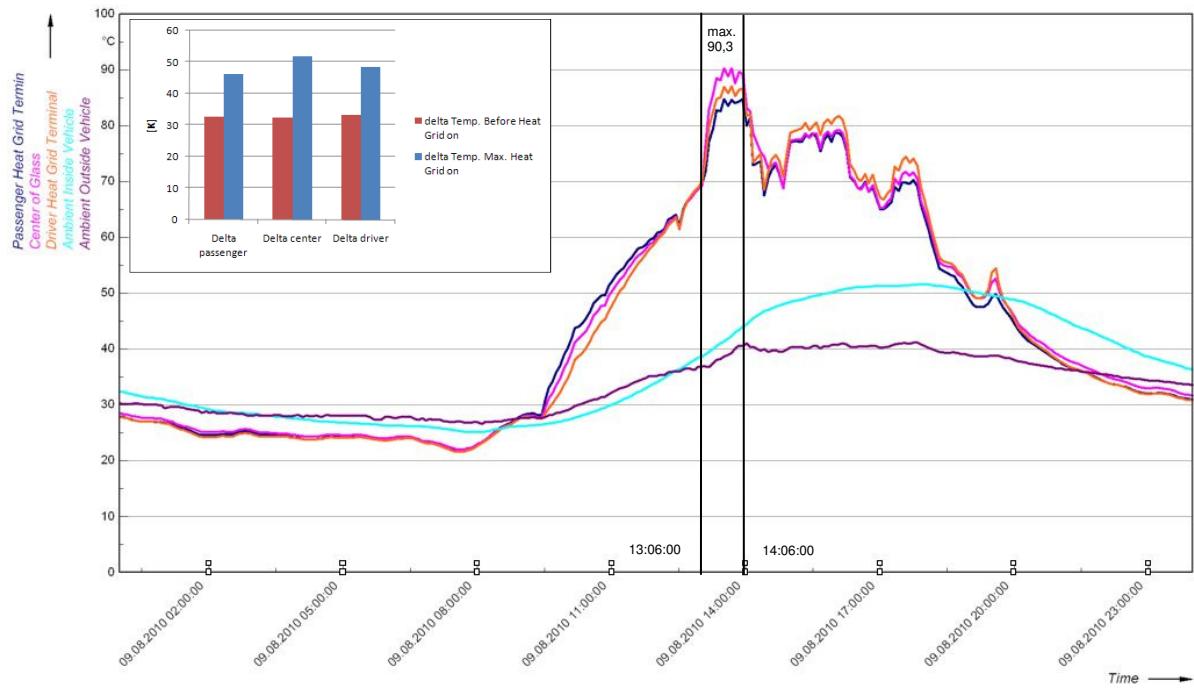


Figure 19: VW Eos - 07.08.2010



**Figure 20: VW Eos - 08.08.2010**



**Figure 21: VW Eos - 09.08.2010**

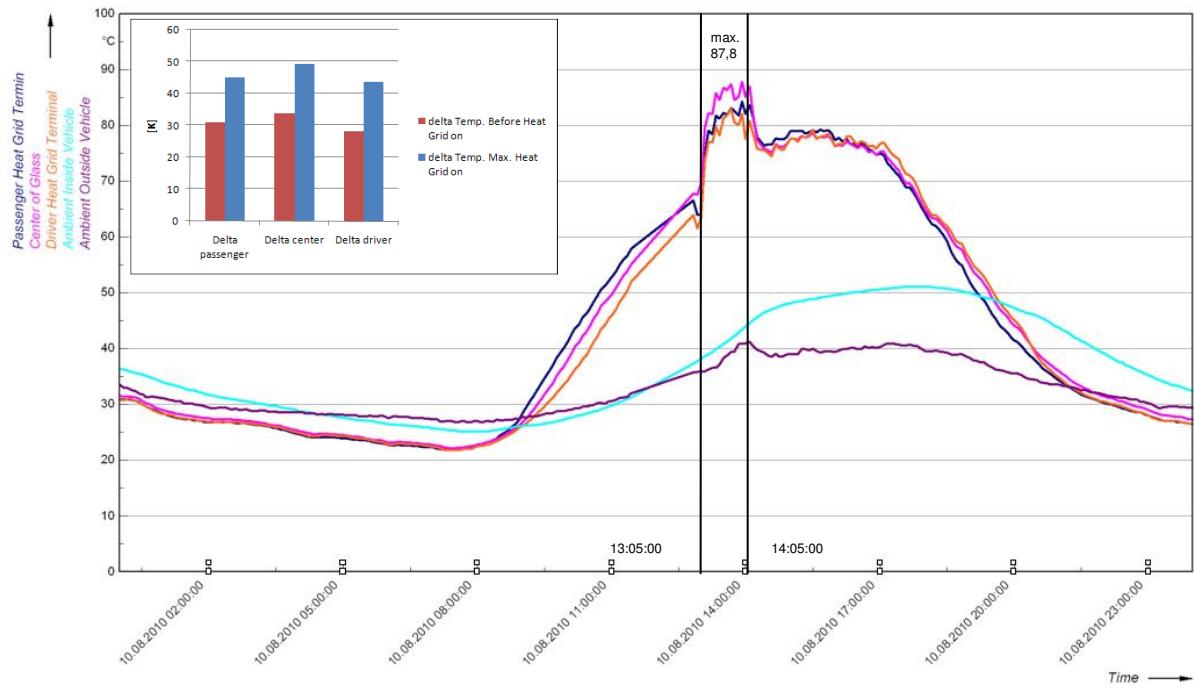


Figure 22: VW Eos - 10.08.2010

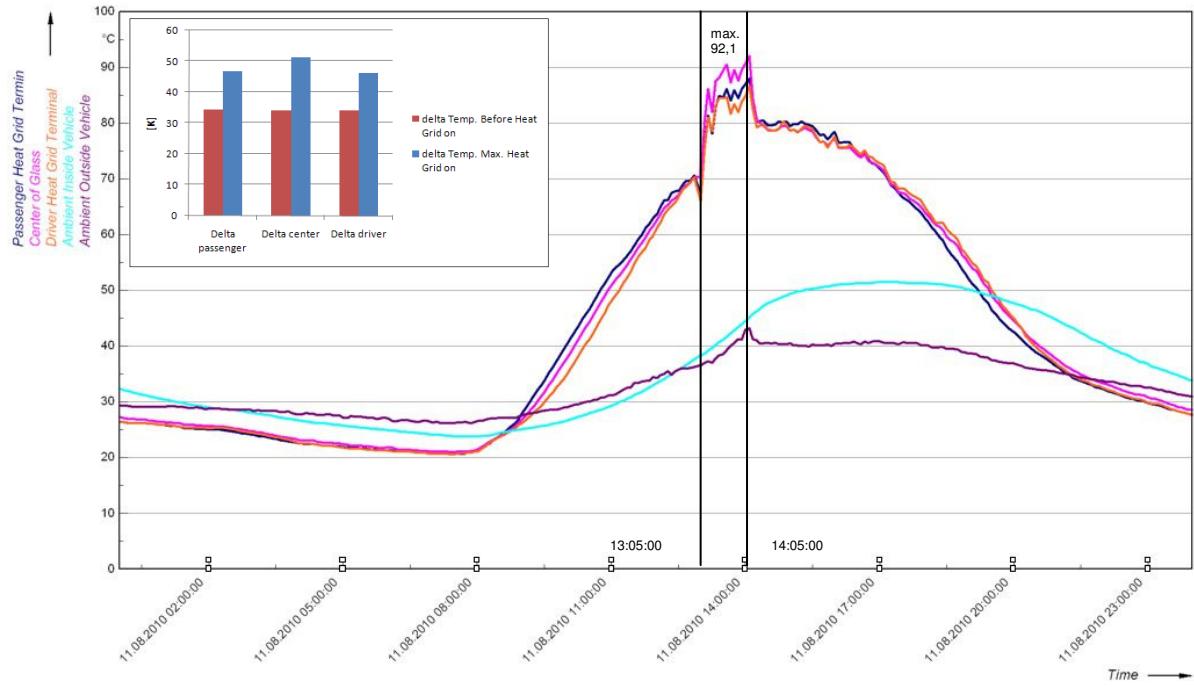


Figure 23: VW Eos - 11.08.2010

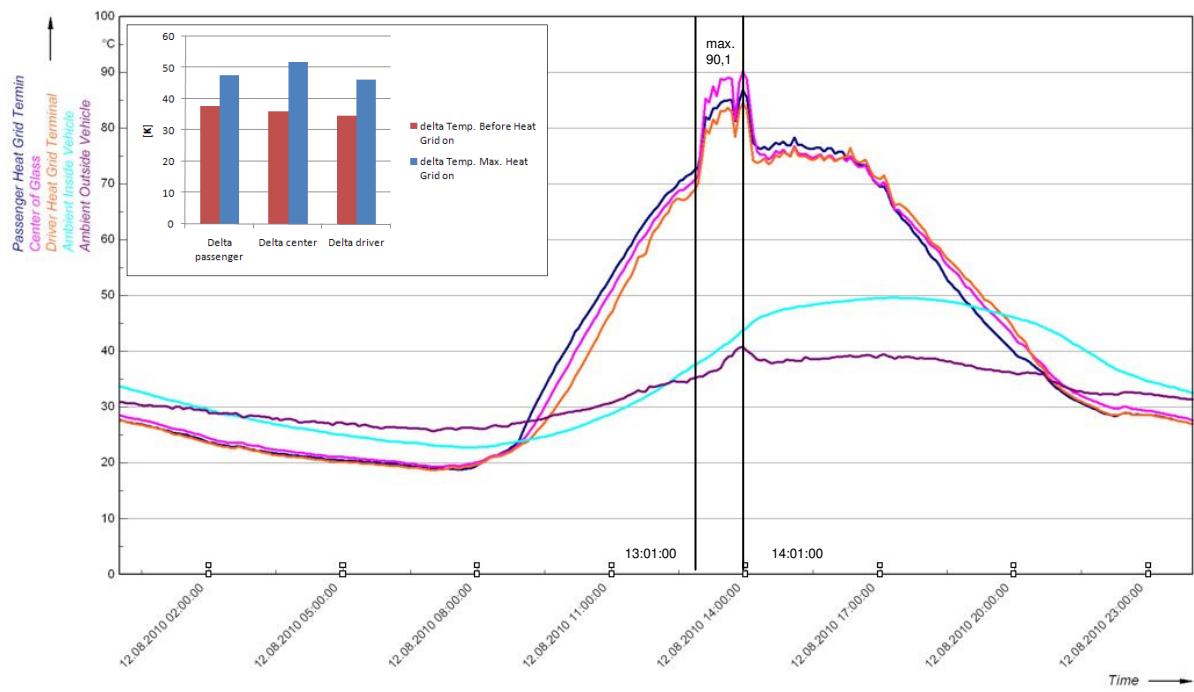


Figure 24: VW Eos - 12.08.2010

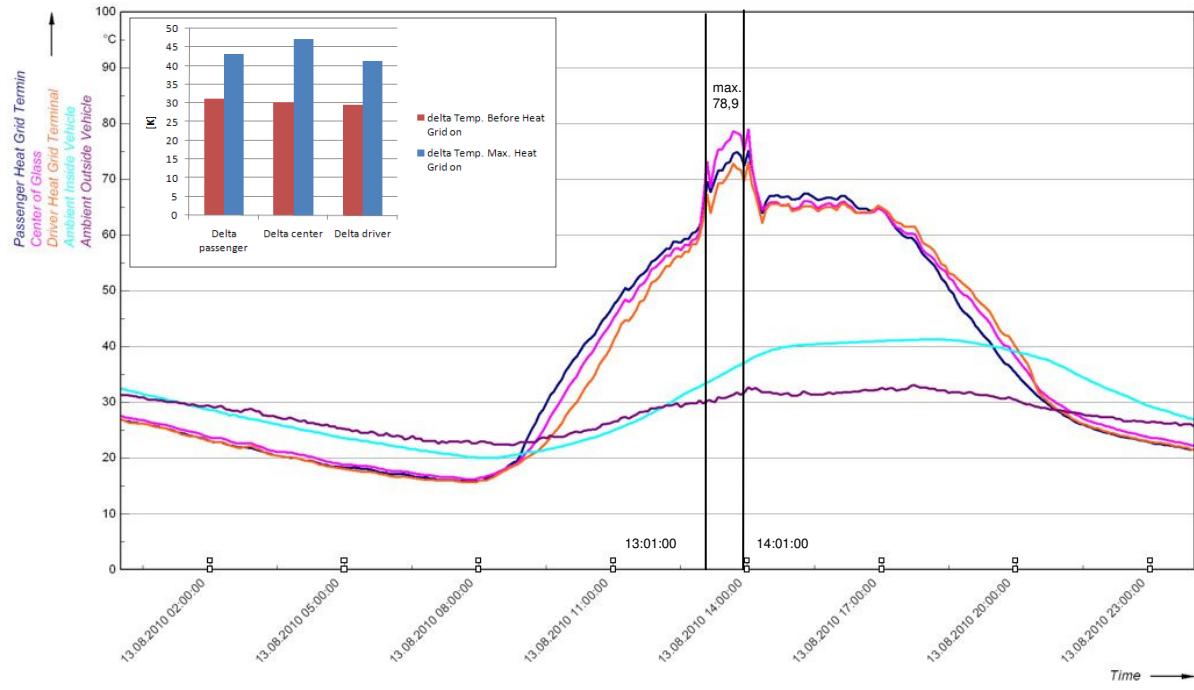


Figure 25: VW Eos - 13.08.2010

## ii. Skoda Octavia

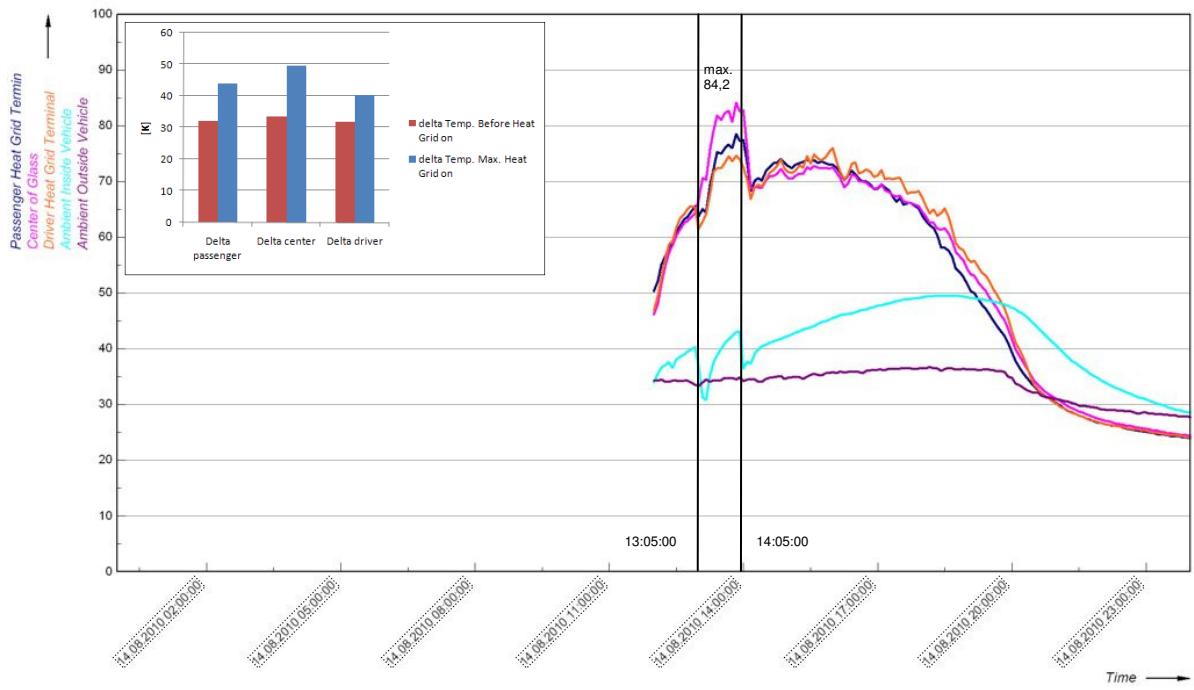


Figure 26: Skoda Octavia - 14.08.2010

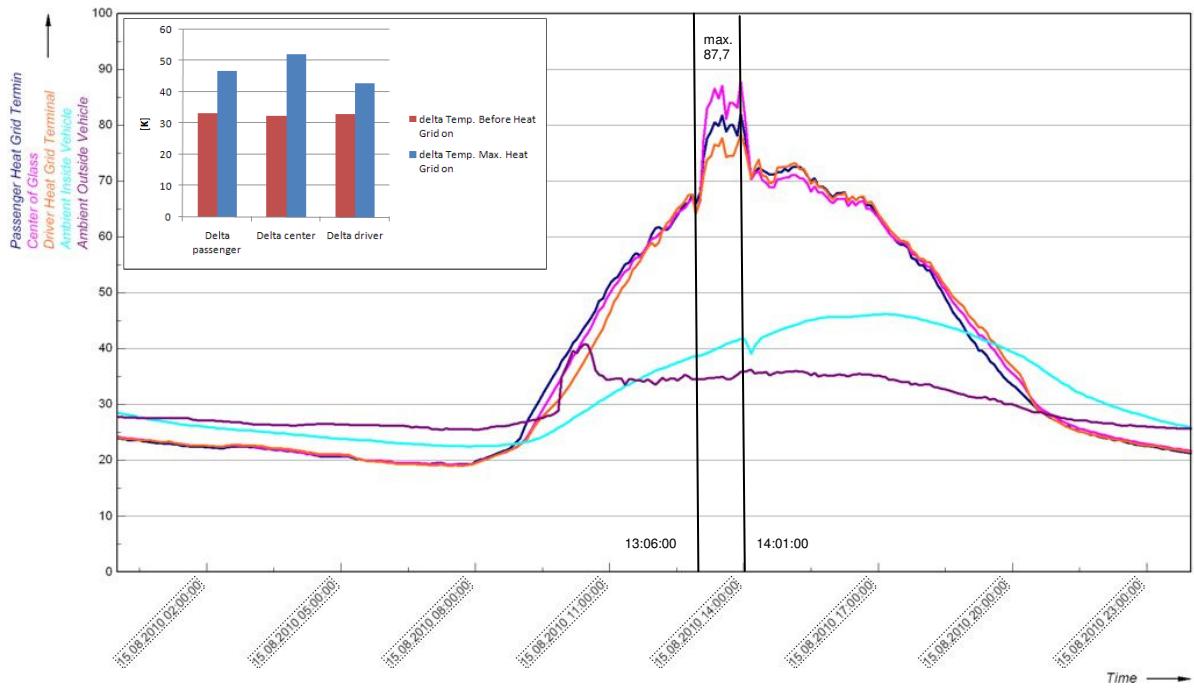


Figure 27: Skoda Octavia - 15.08.2010

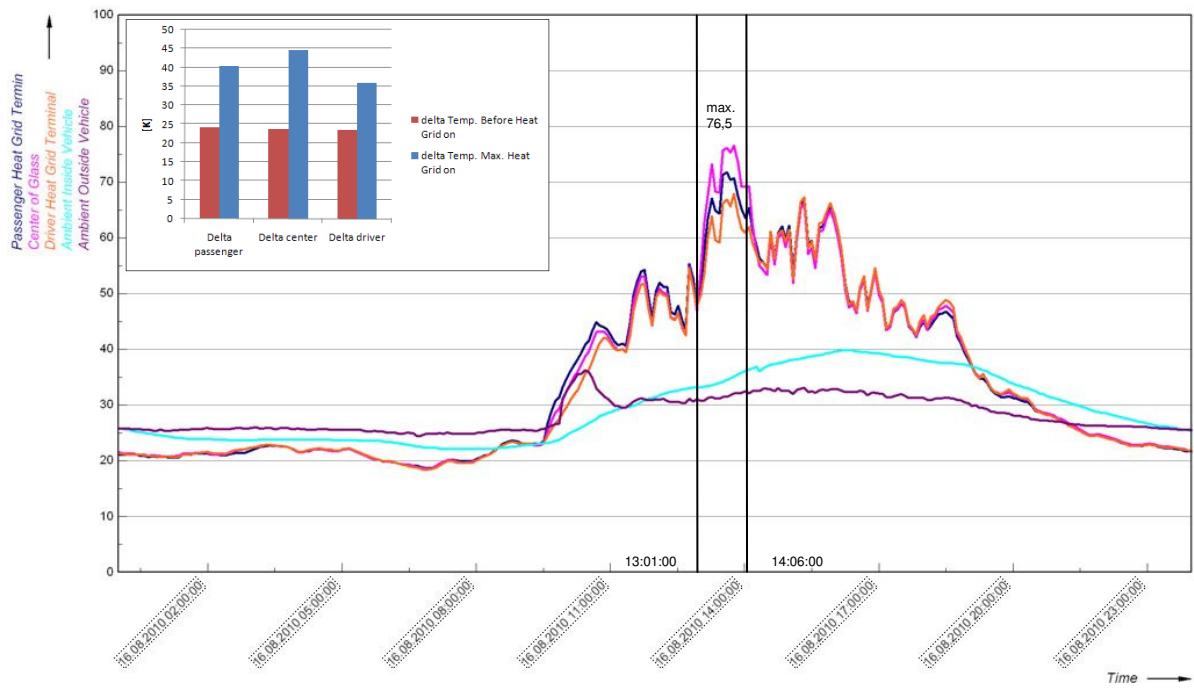


Figure 28: Skoda Octavia - 16.08.2010

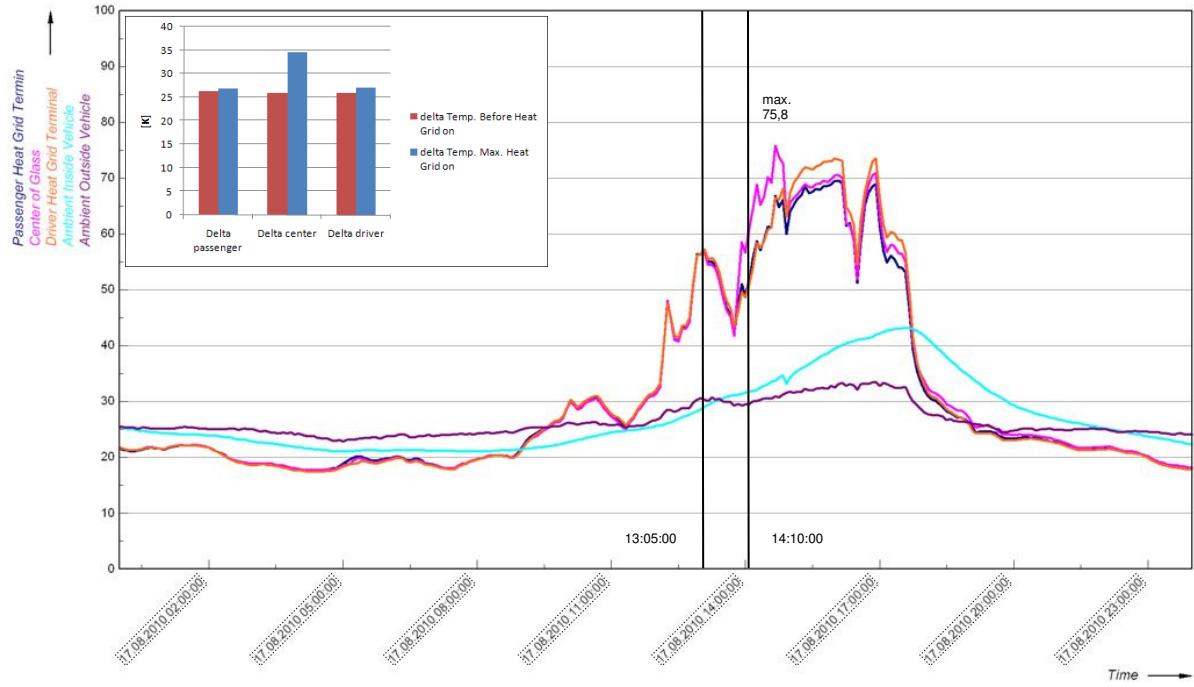


Figure 29: Skoda Octavia - 17.08.2010

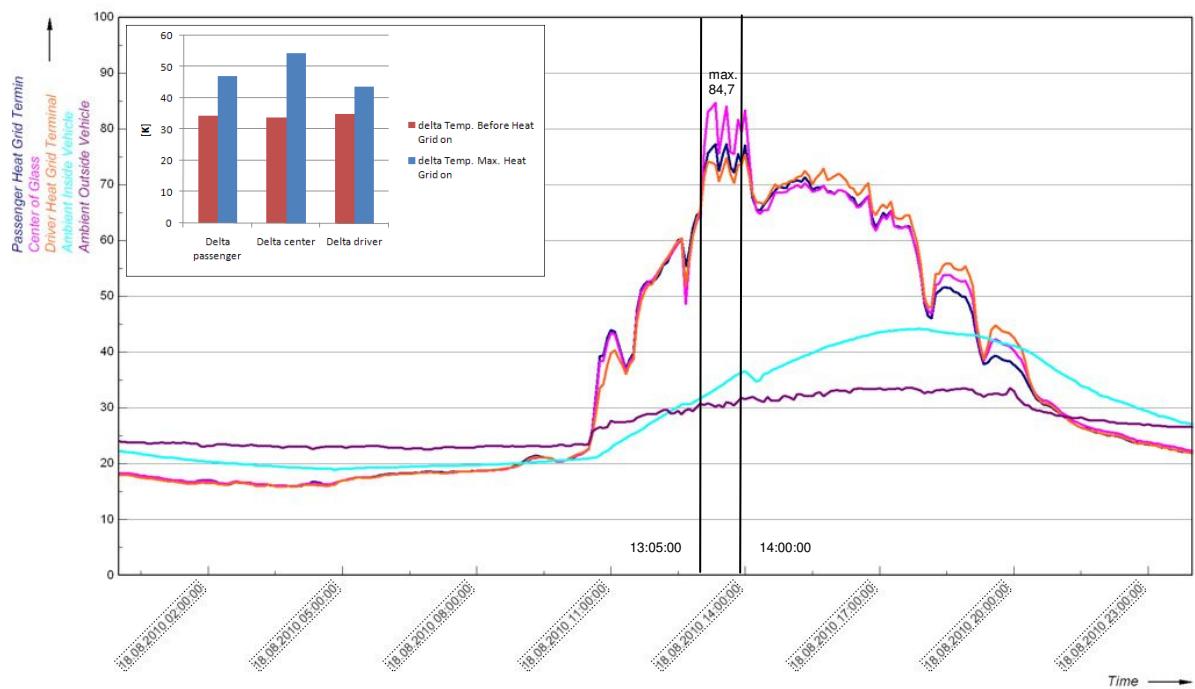


Figure 30: Skoda Octavia - 18.08.2010

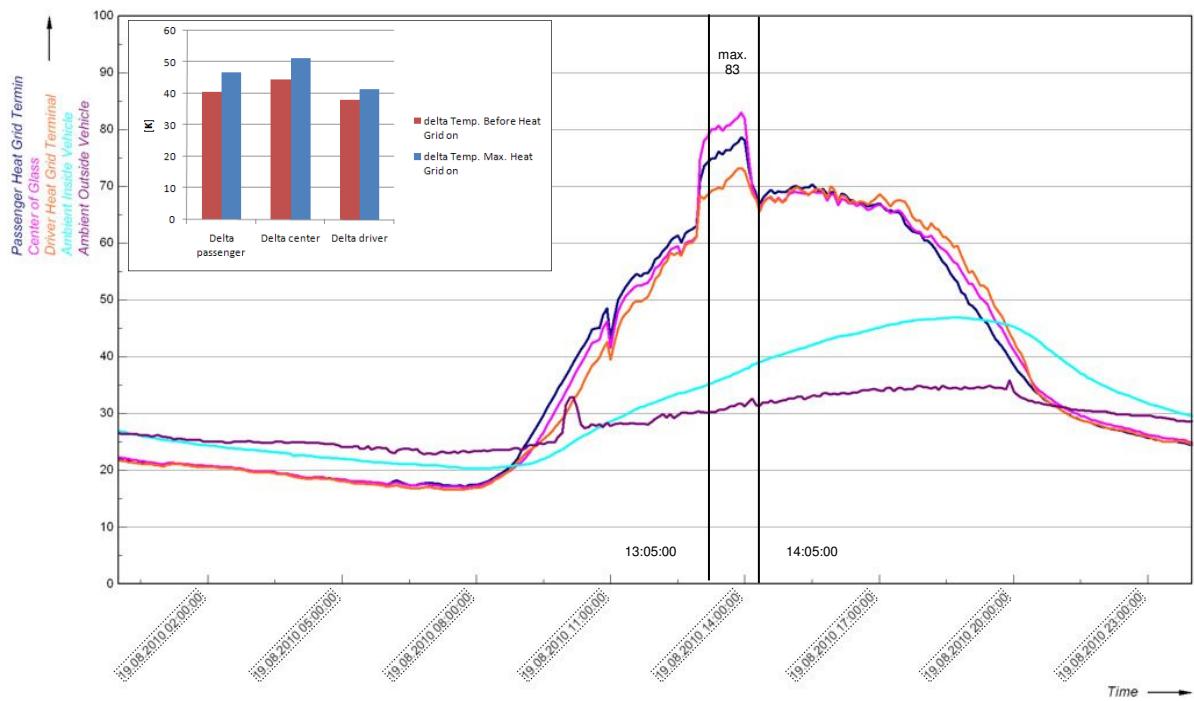


Figure 31: Skoda Octavia - 19.08.2010

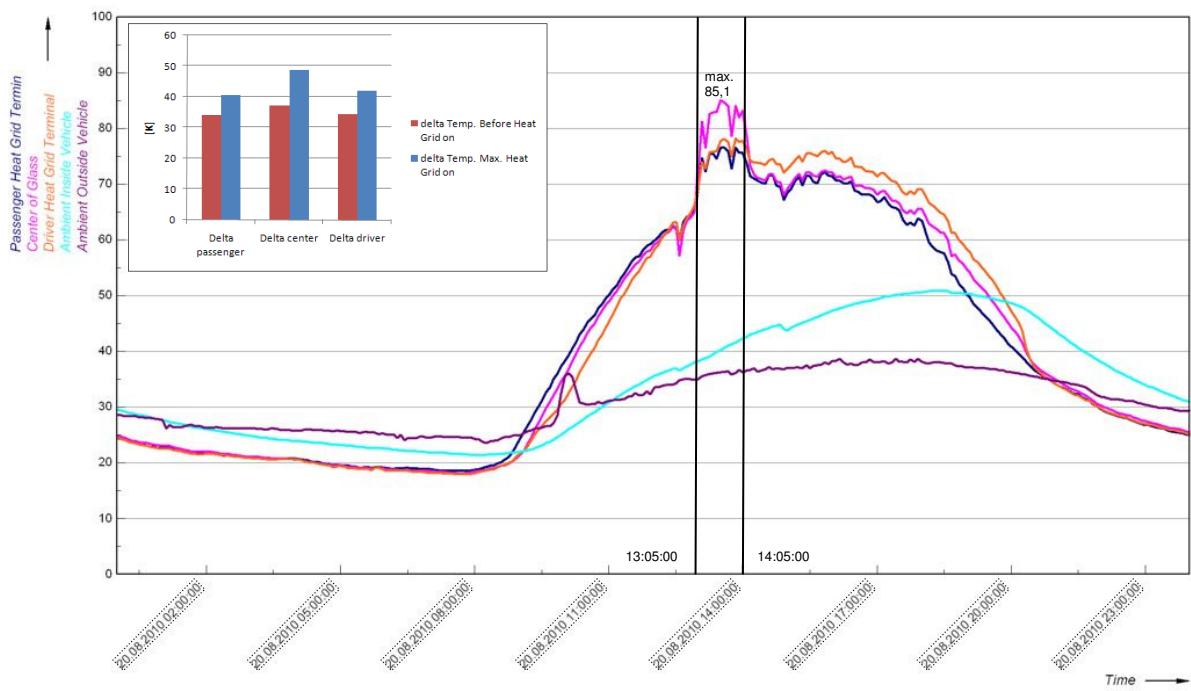


Figure 32: Skoda Octavia - 20.08.2010

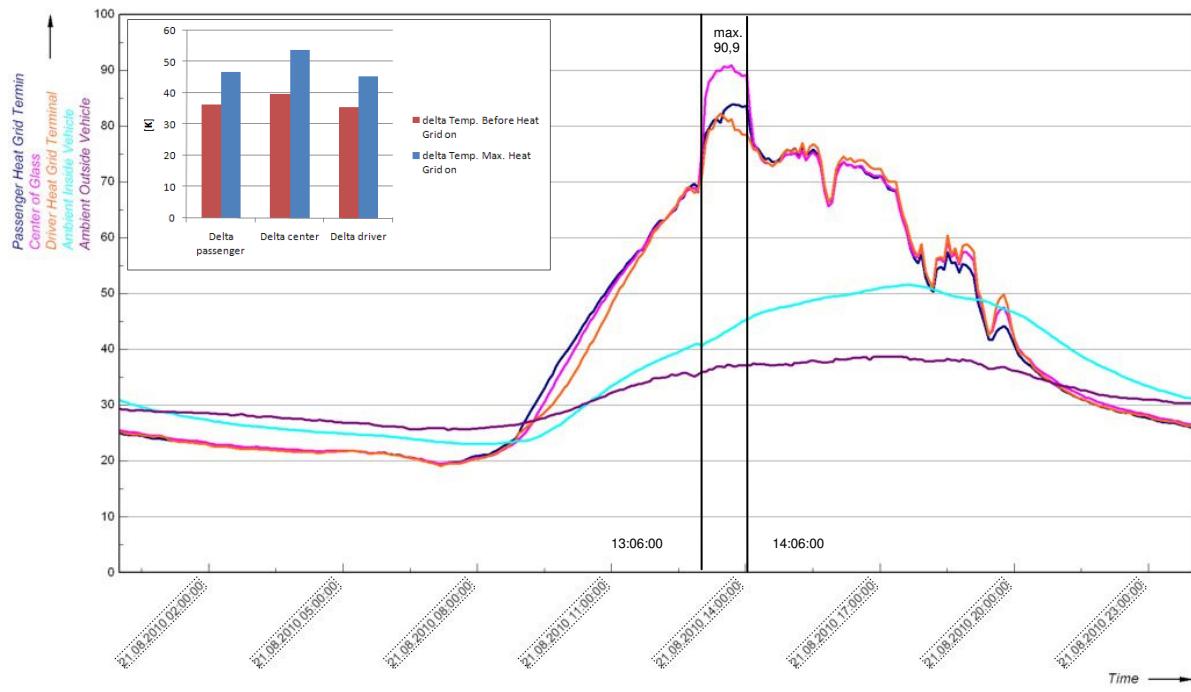


Figure 33: Skoda Octavia - 21.08.2010

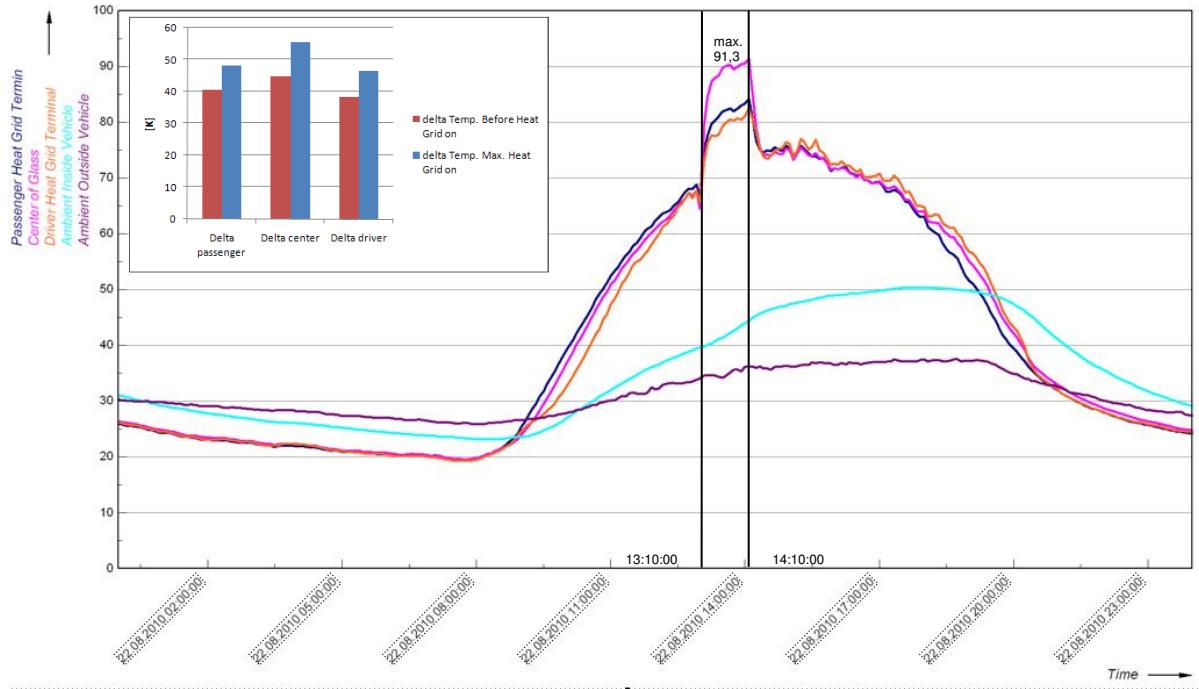


Figure 34: Skoda Octavia - 22.08.2010

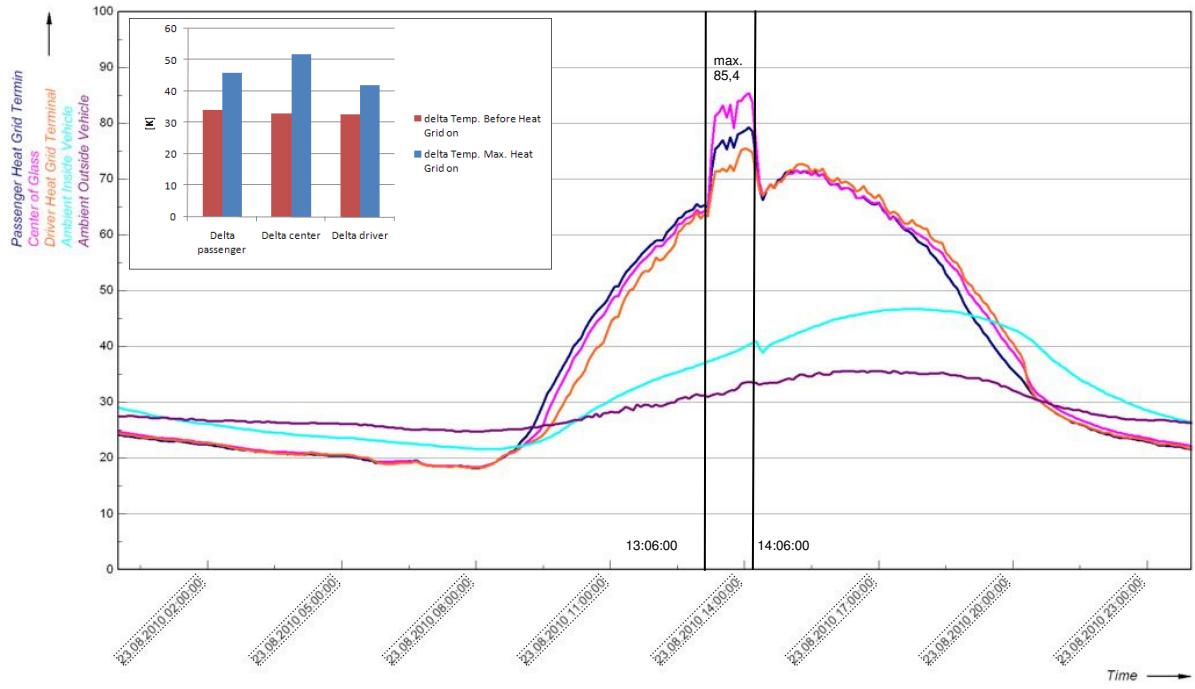


Figure 35: Skoda Octavia - 23.08.2010

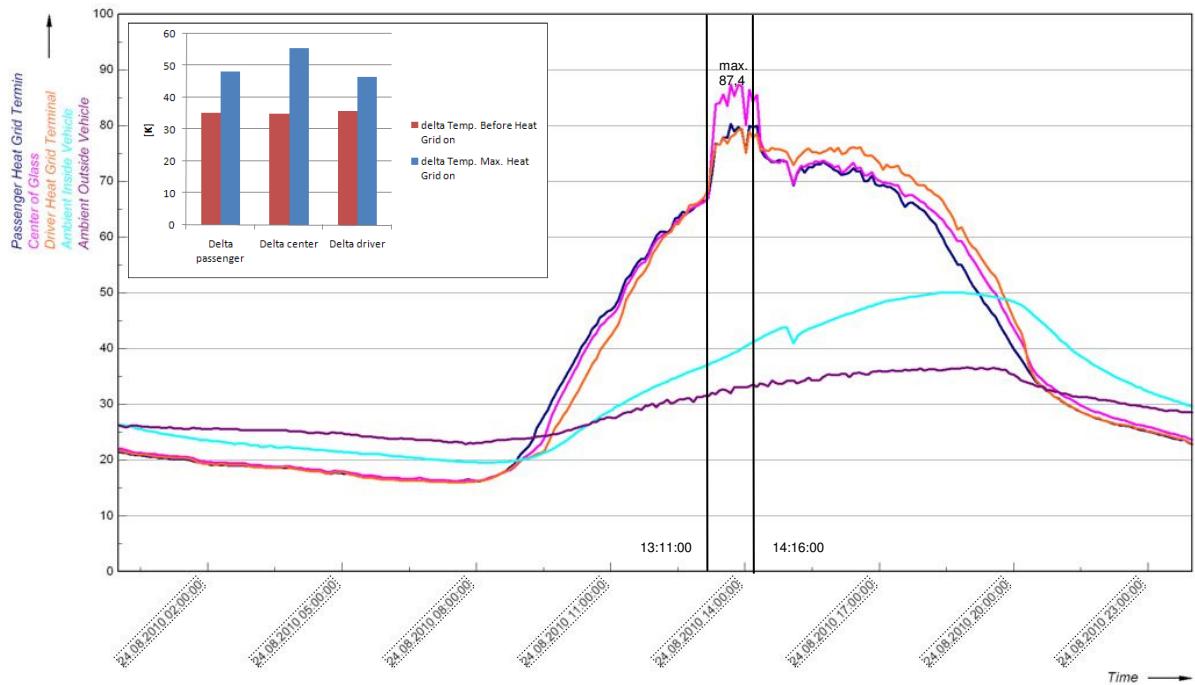


Figure 36: Skoda Octavia - 24.08.2010

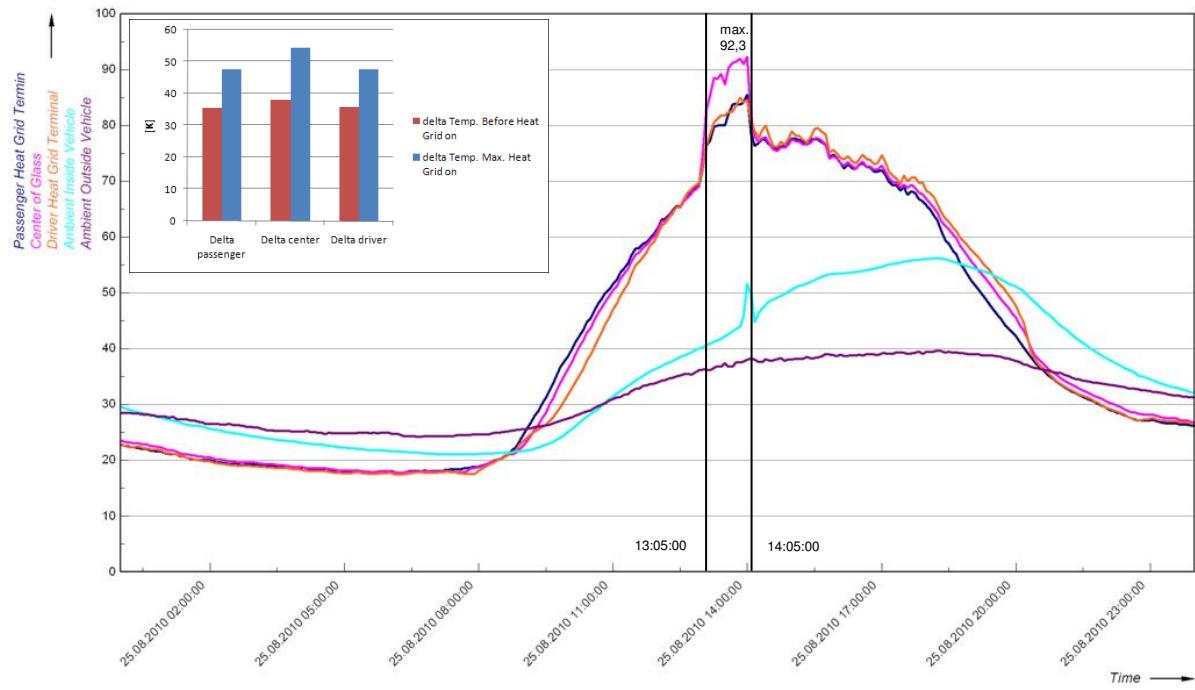


Figure 37: Skoda Octavia - 25.08.2010

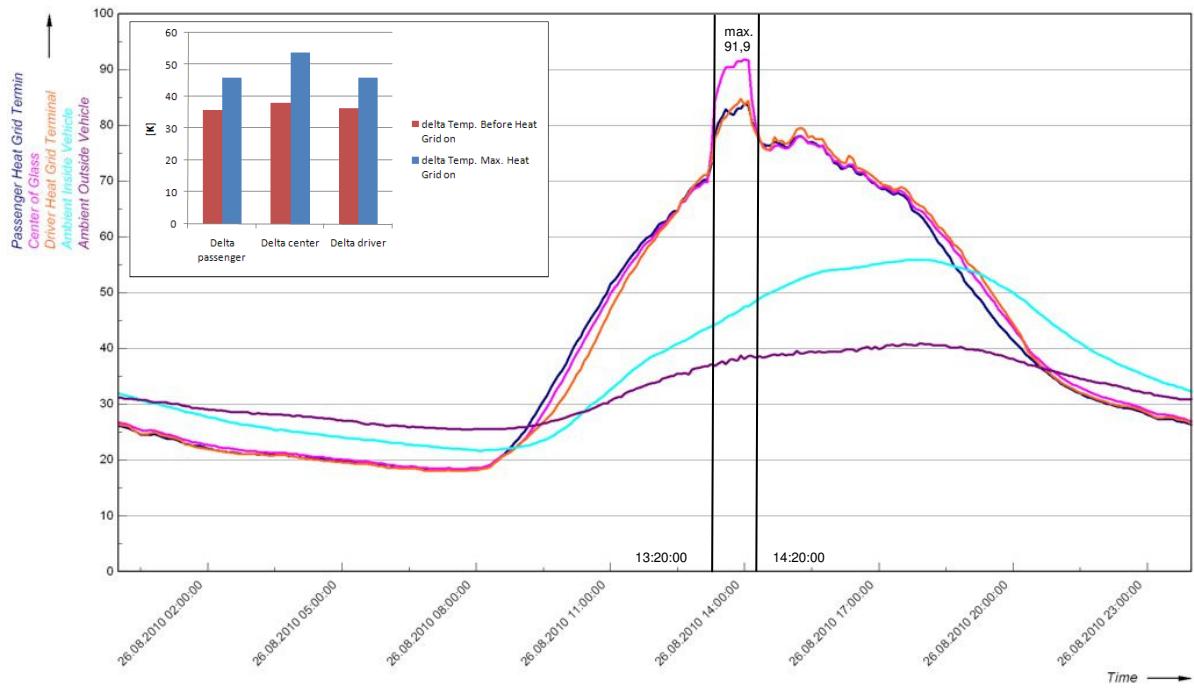


Figure 38: Skoda Octavia - 26.08.2010

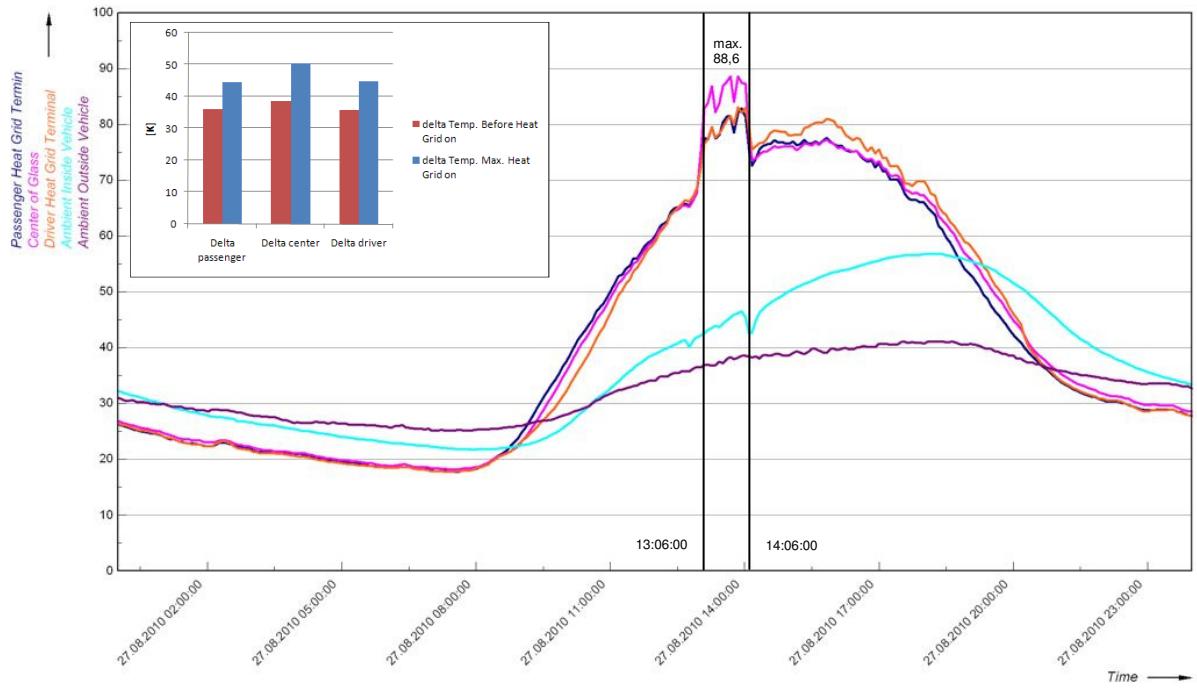


Figure 39: Skoda Octavia - 27.08.2010

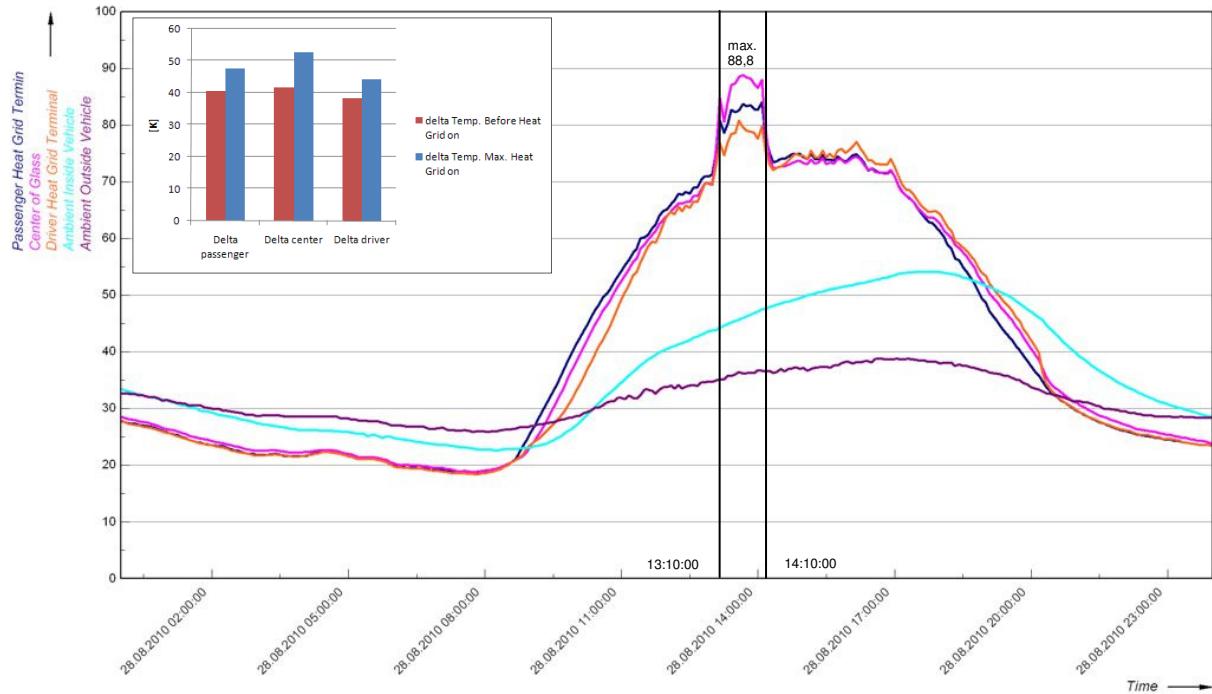


Figure 40: Skoda Octavia - 28.08.2010

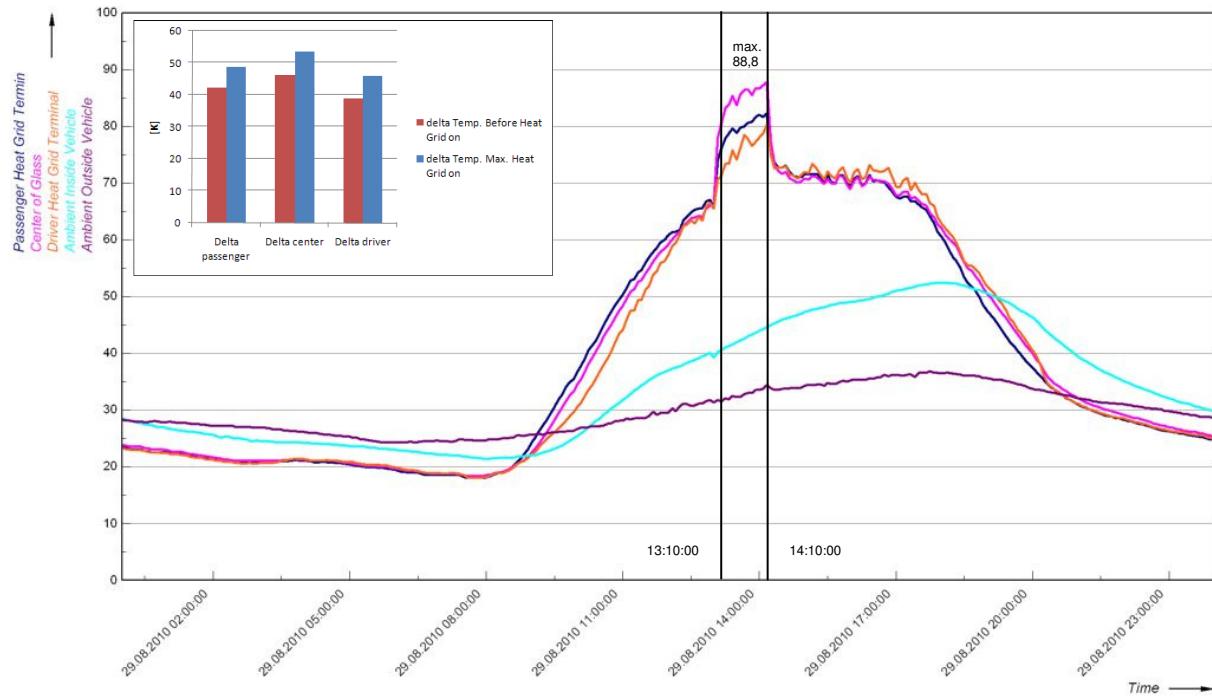


Figure 41: Skoda Octavia - 29.08.2010

### iii. Audi TT

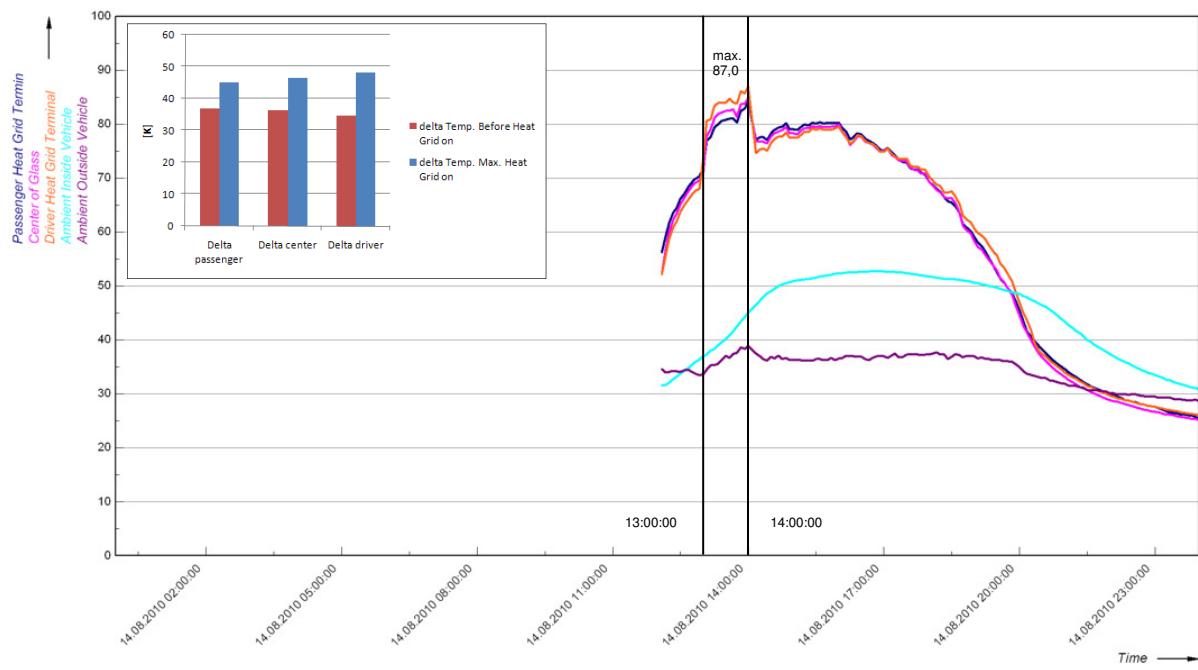


Figure 42: Audi TT - 14.08.2010

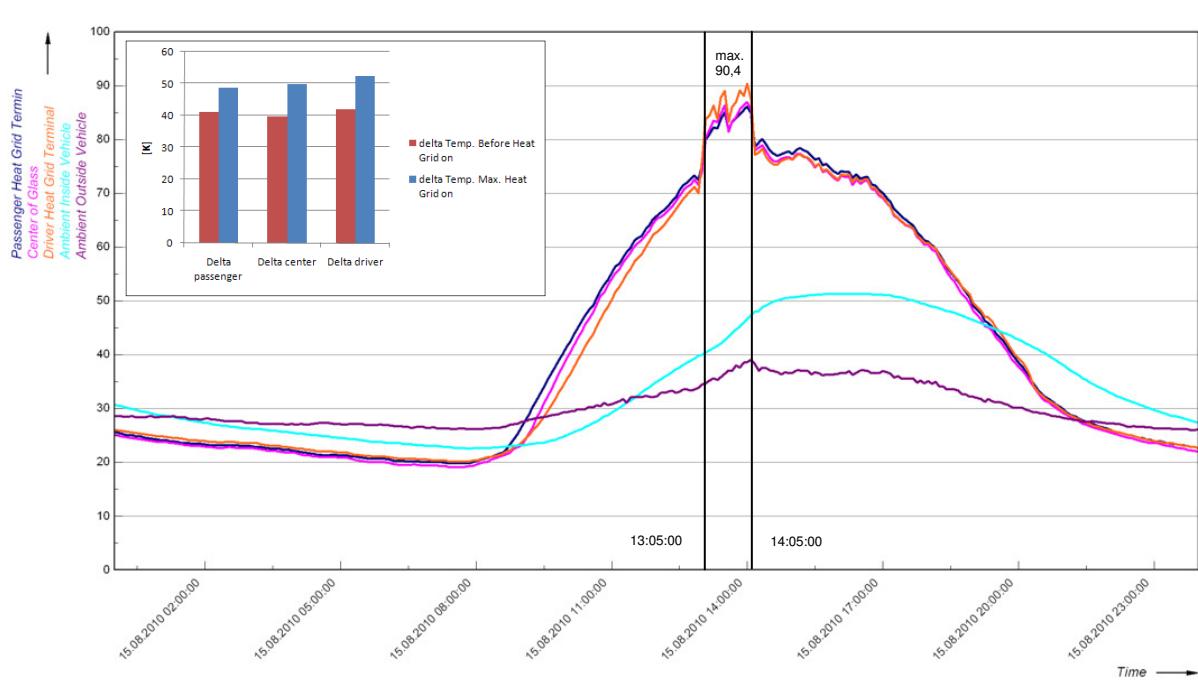
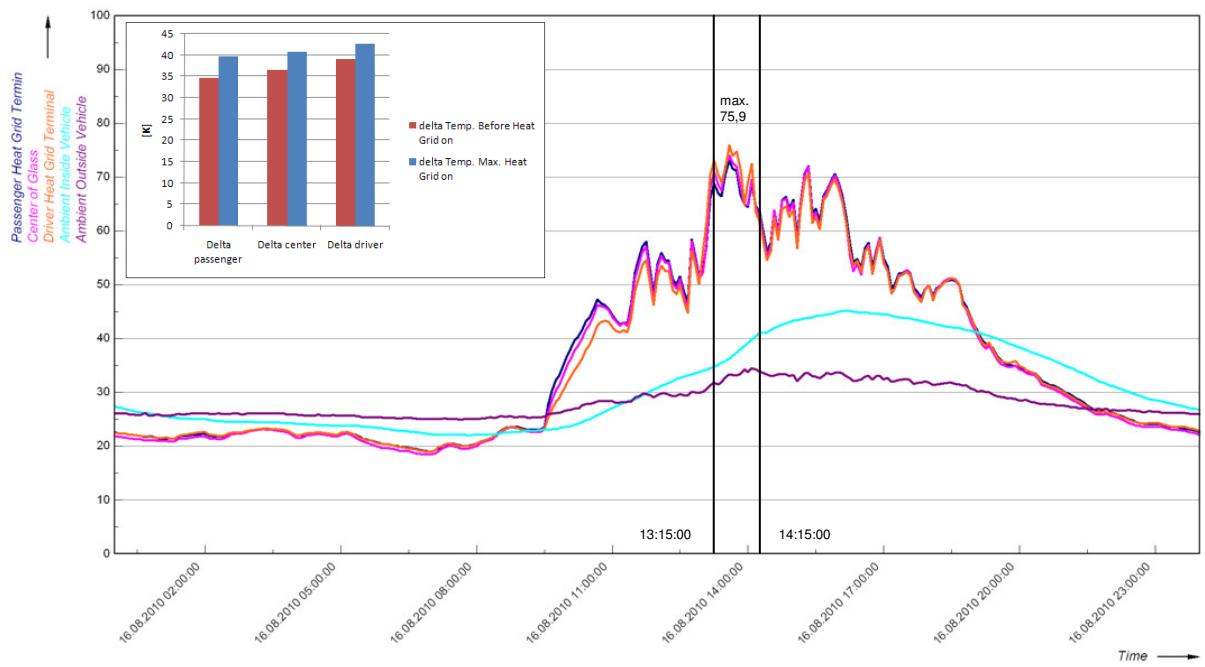
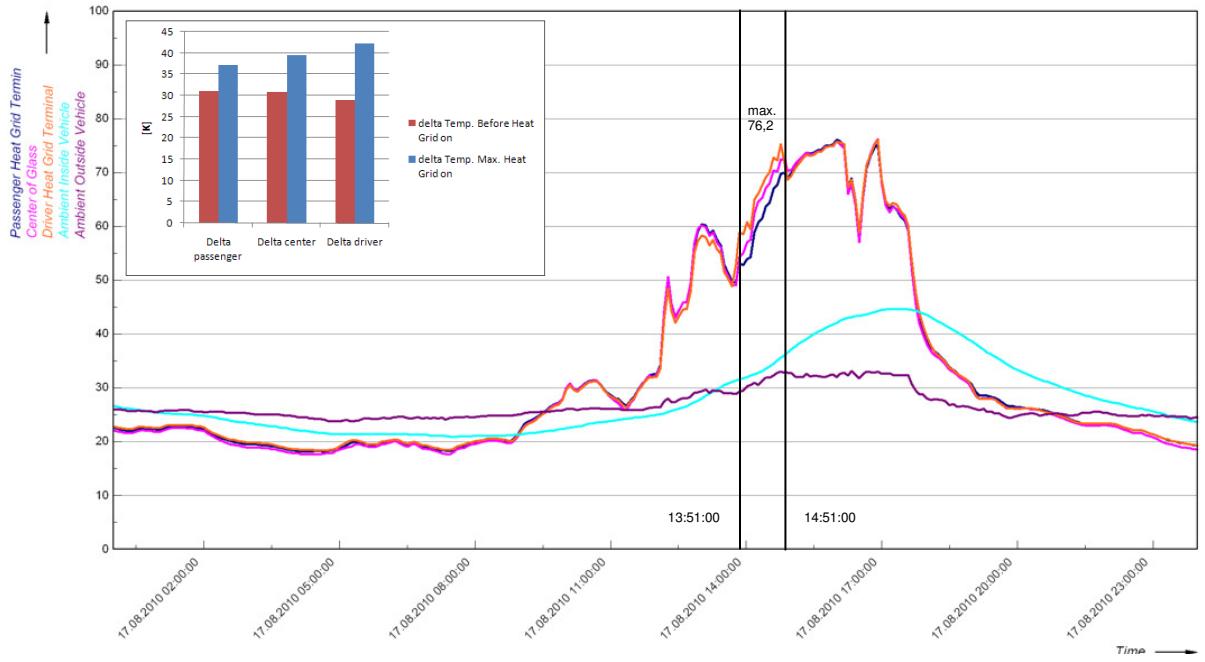


Figure 43: Audi TT - 15.08.2010



**Figure 44: Audi TT - 16.08.2010**



**Figure 45: Audi TT - 17.08.2010**

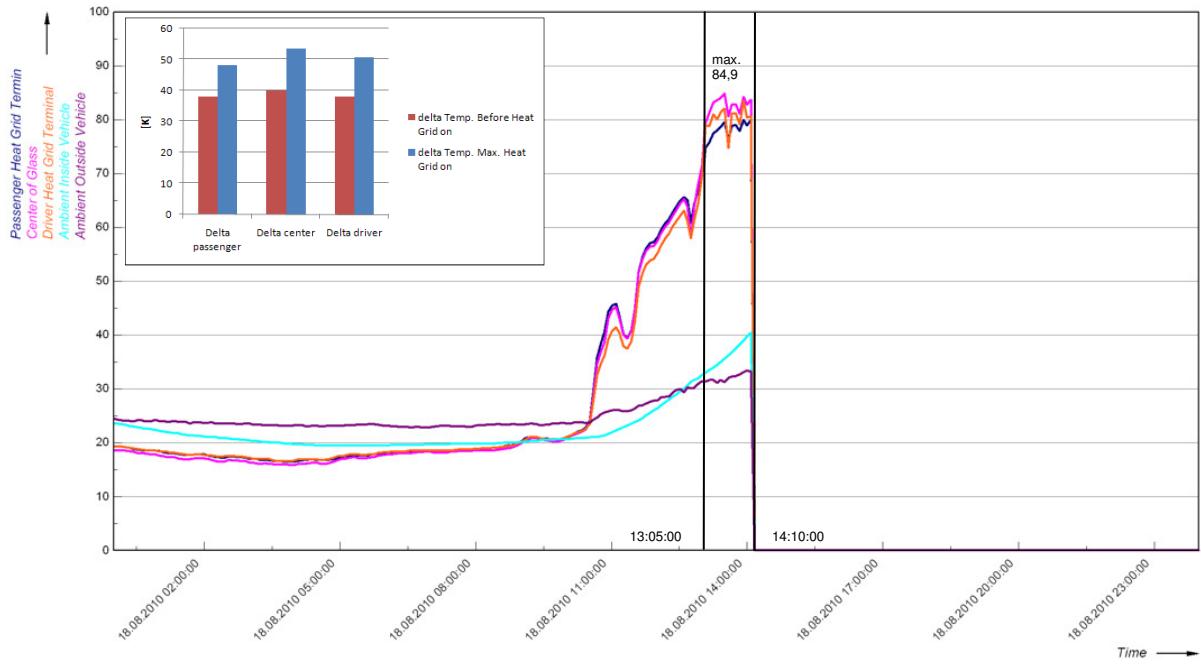


Figure 46: Audi TT - 18.08.2010

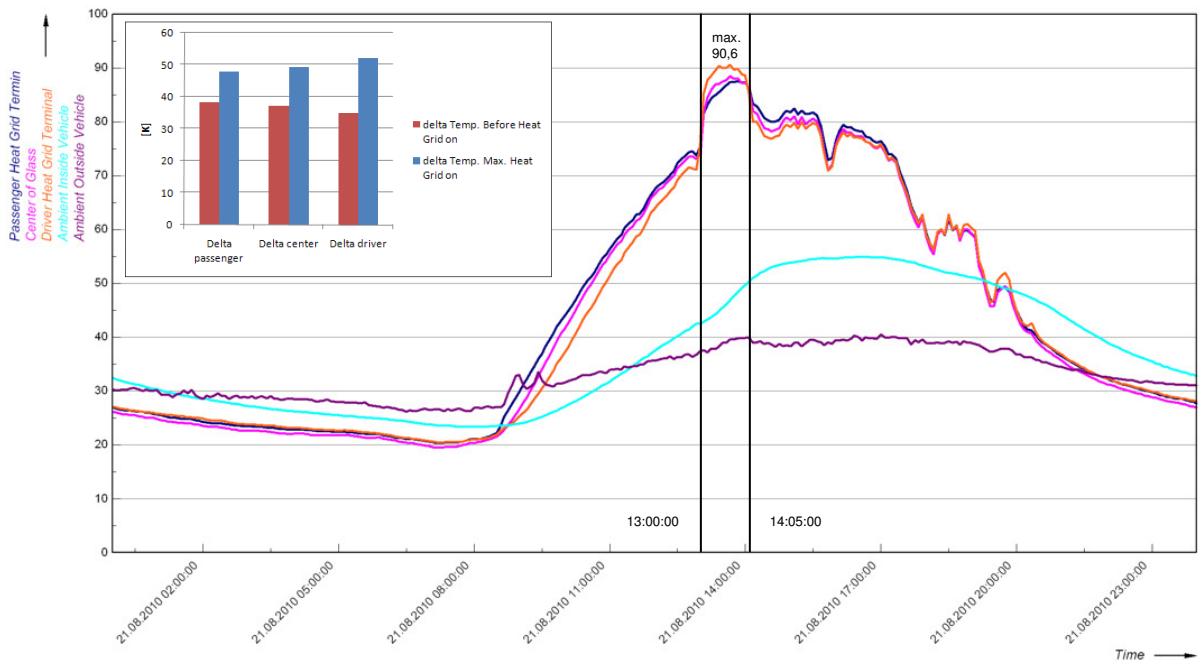


Figure 47: Audi TT - 21.08.2010

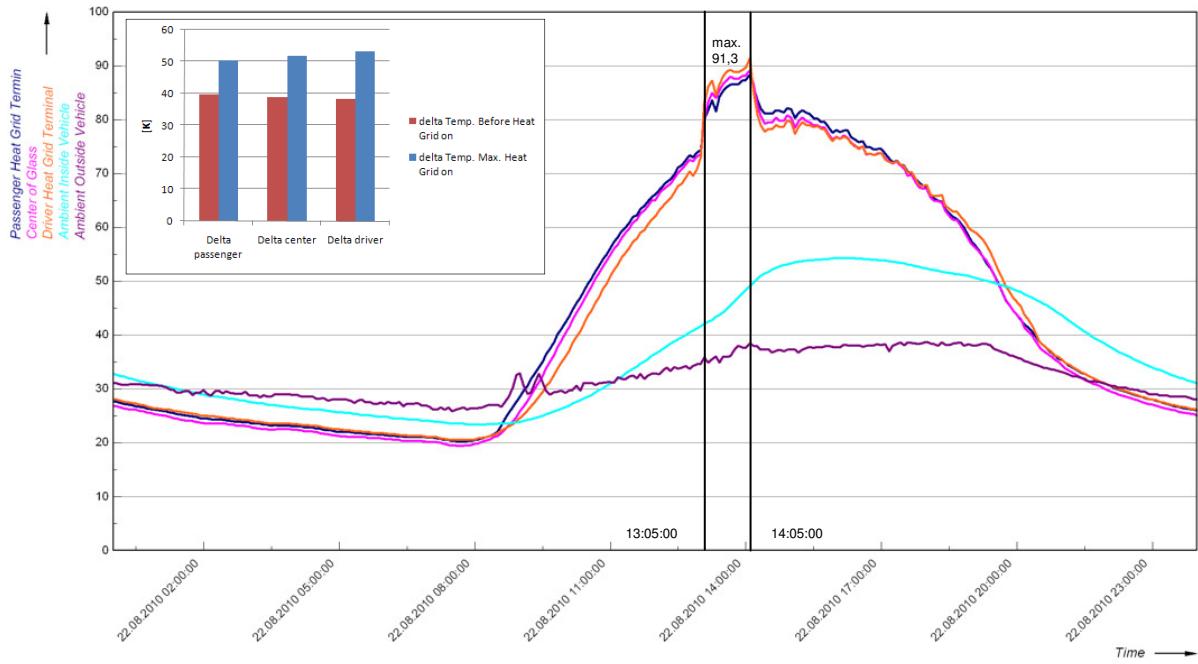


Figure 48: Audi TT - 22.08.2010

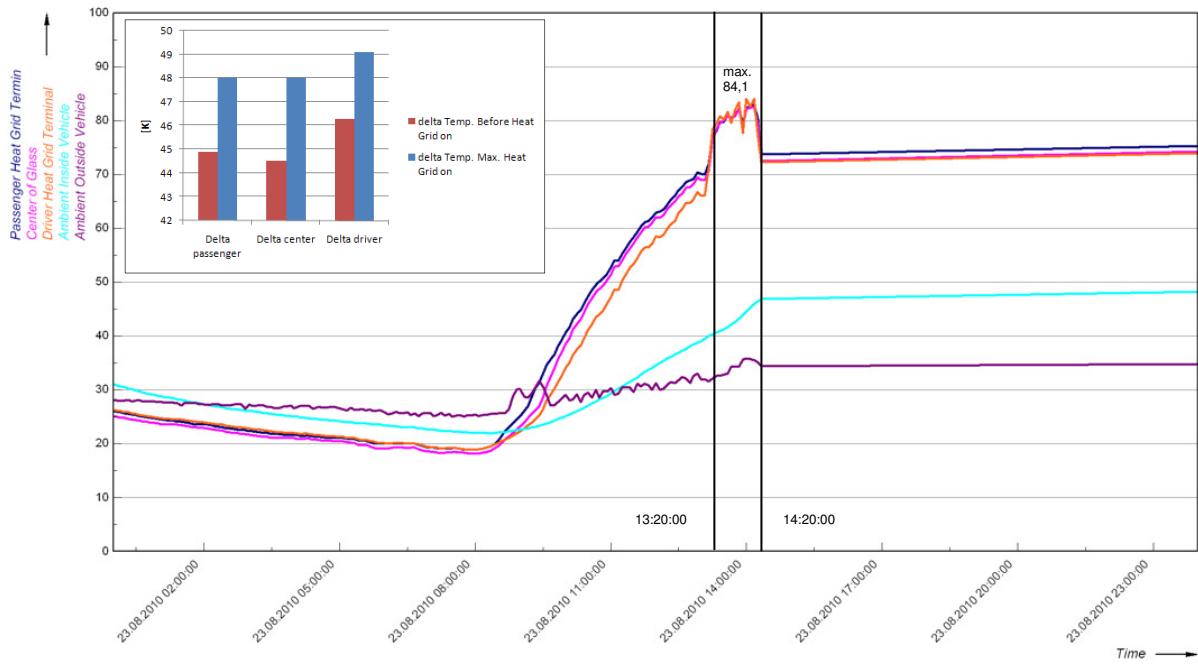
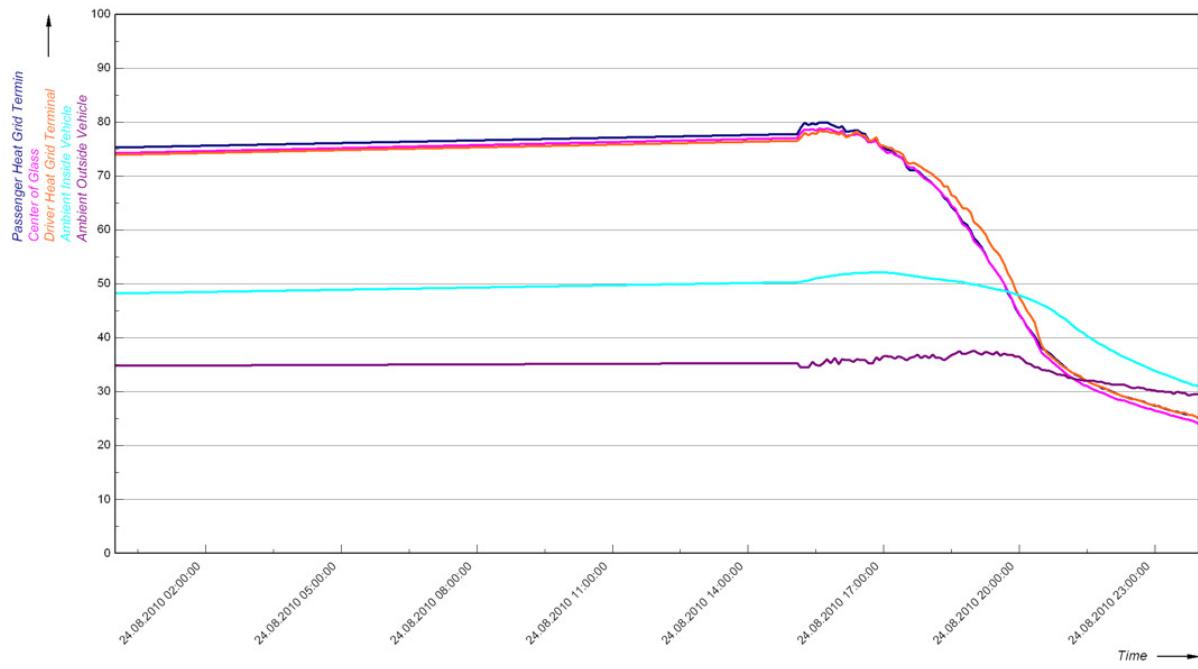
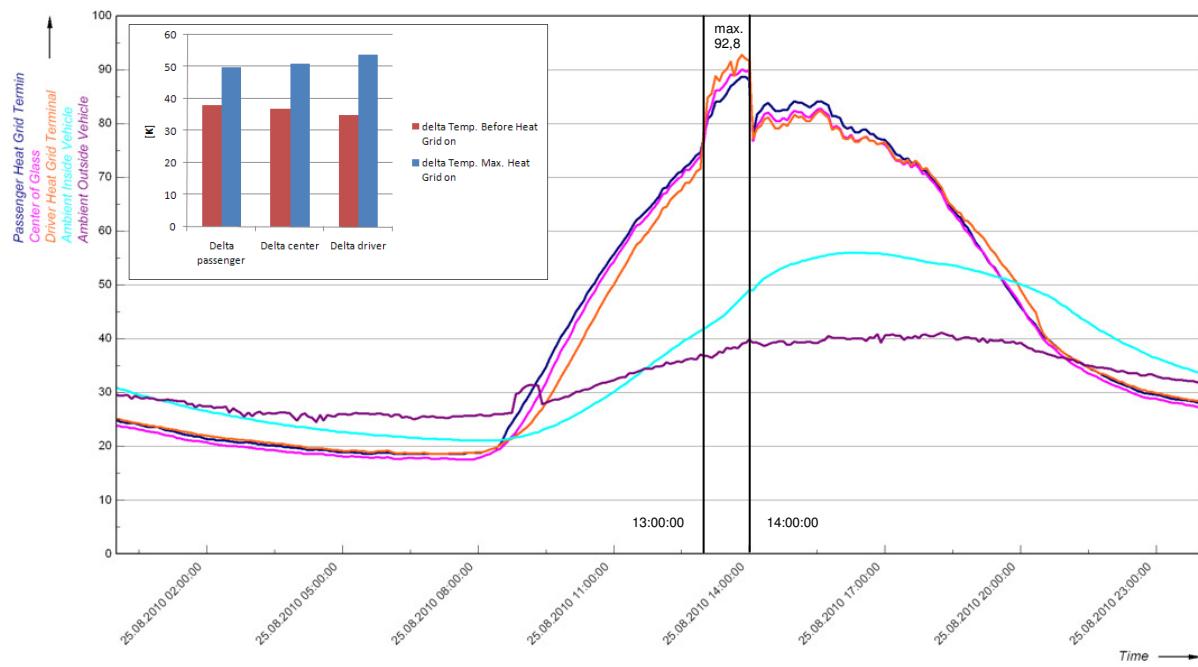


Figure 49: Audi TT - 23.08.2010



**Figure 50: Audi TT - 24.08.2010**



**Figure 51: Audi TT - 25.08.2010**

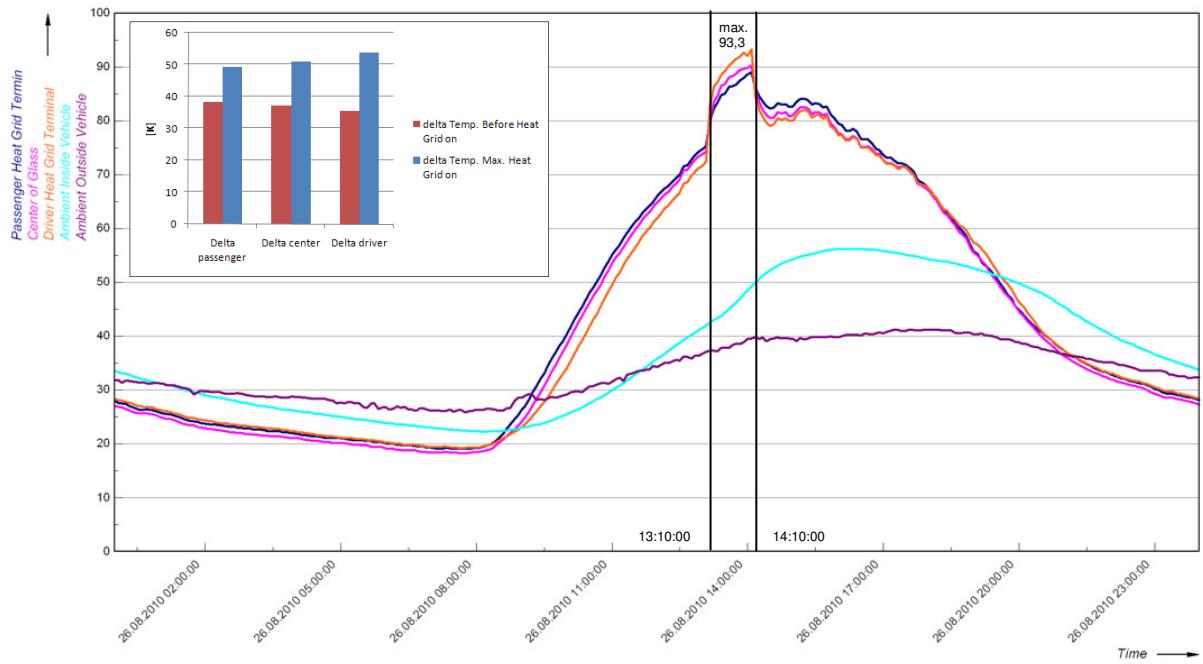


Figure 52: Audi TT - 26.08.2010

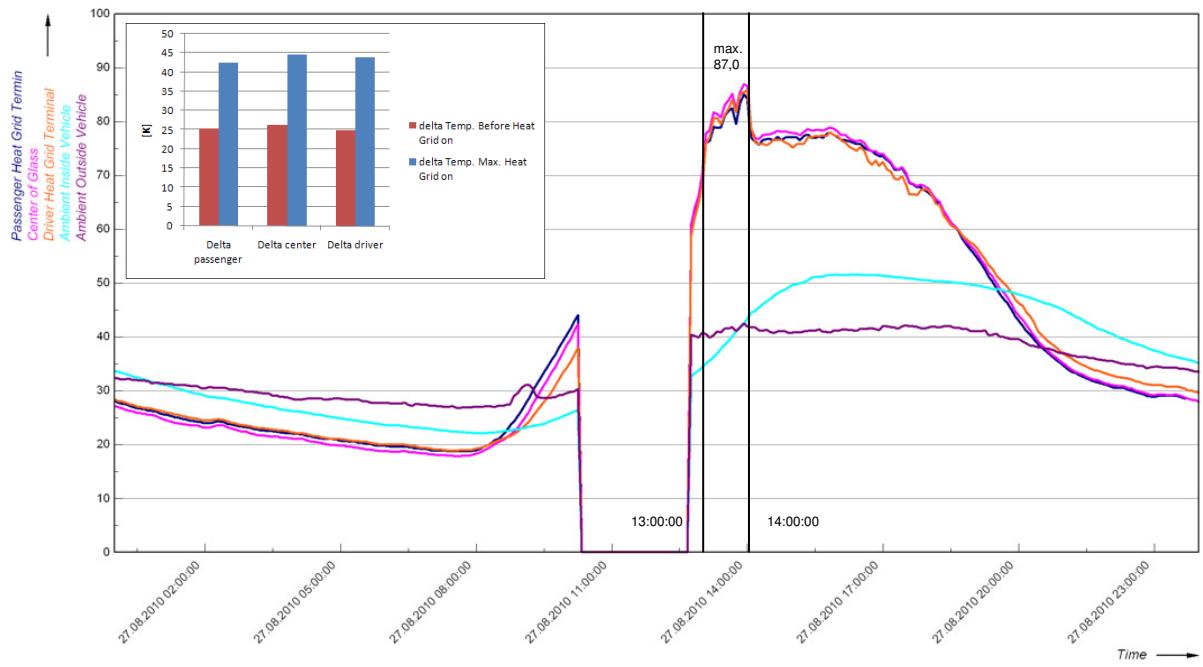
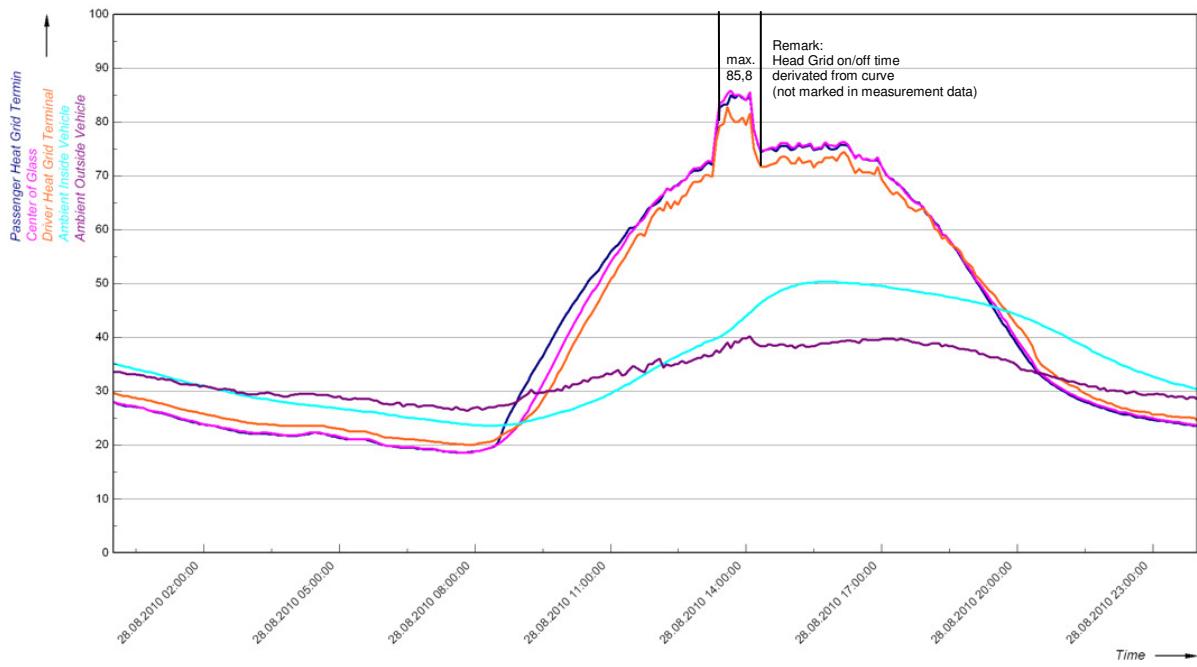
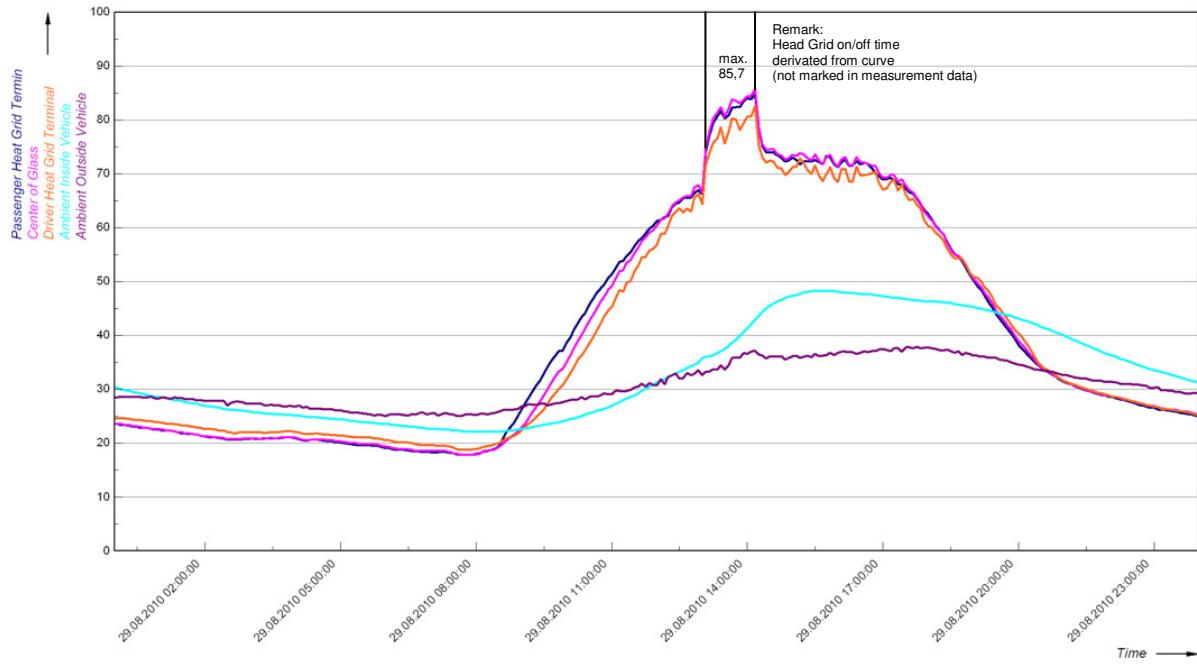


Figure 53: Audi TT - 27.08.2010



**Figure 54: Audi TT - 28.08.2010**



**Figure 55: Audi TT - 29.08.2010**

#### iv. Peugeot 407

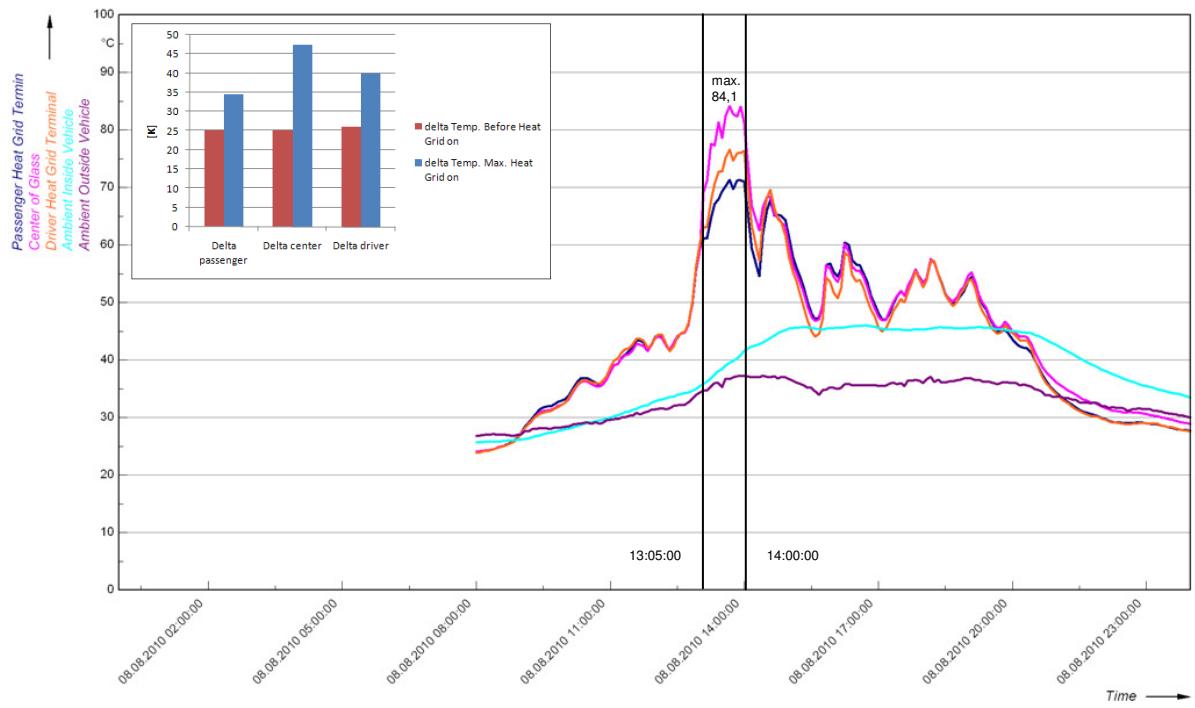


Figure 56: Peugeot 407 - 08.08.2010

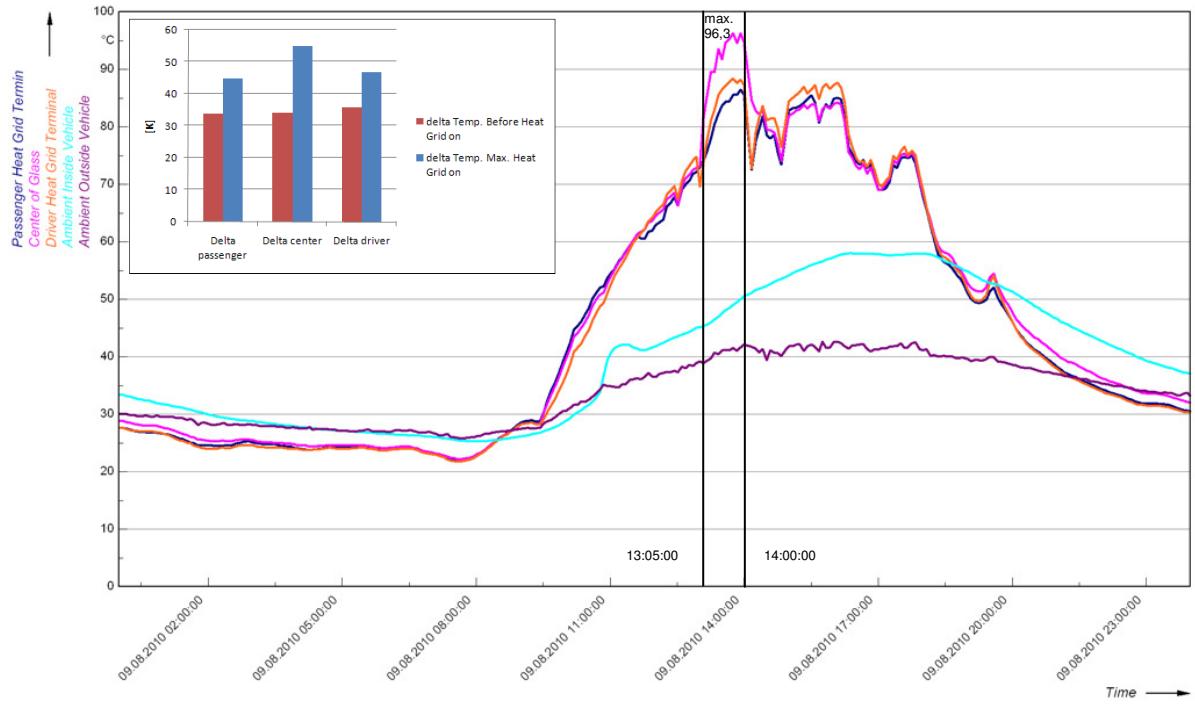


Figure 57: Peugeot 407 - 09.08.2010

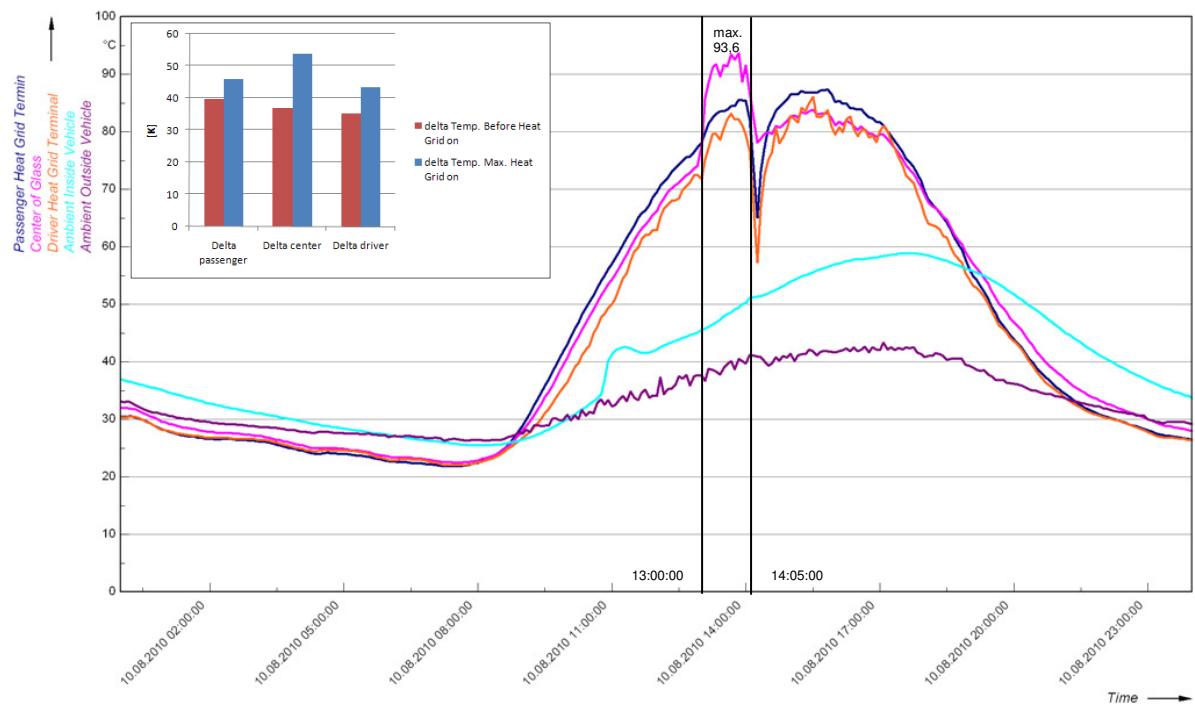


Figure 58: Peugeot 407 - 10.08.2010

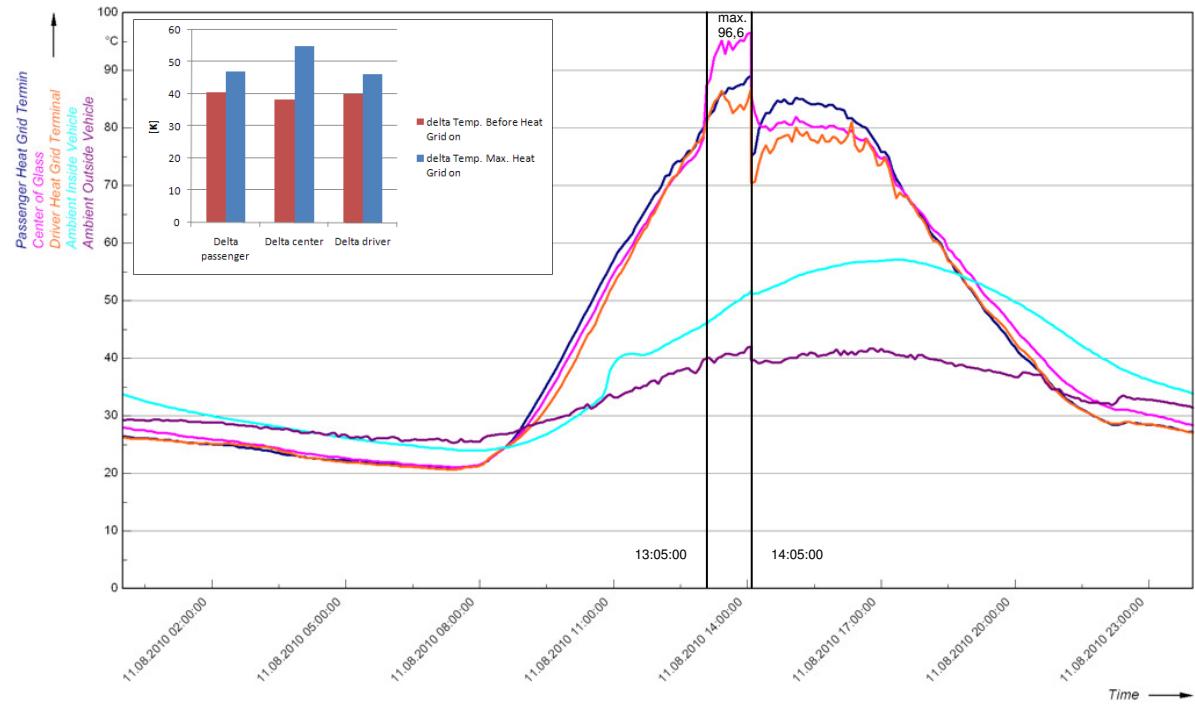


Figure 59: Peugeot 407 - 11.08.2010

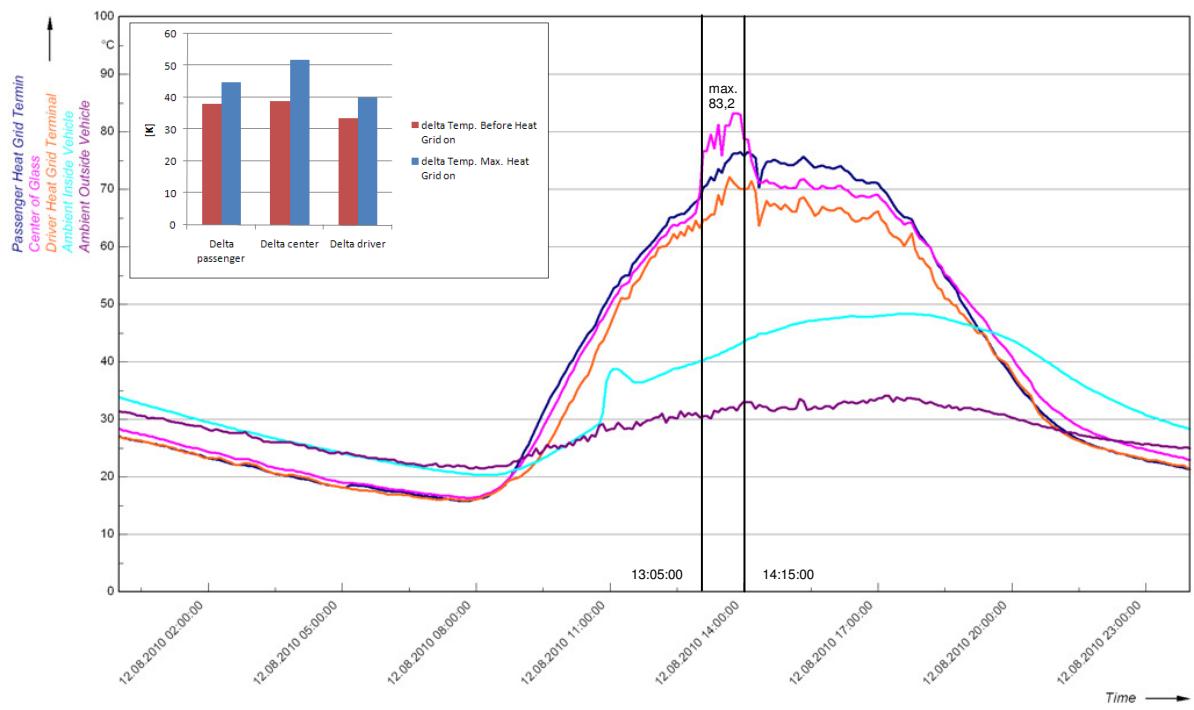


Figure 60: Peugeot 407 - 12.08.2010

## b. Measured temperature rise for every single car

### i. VW Eos

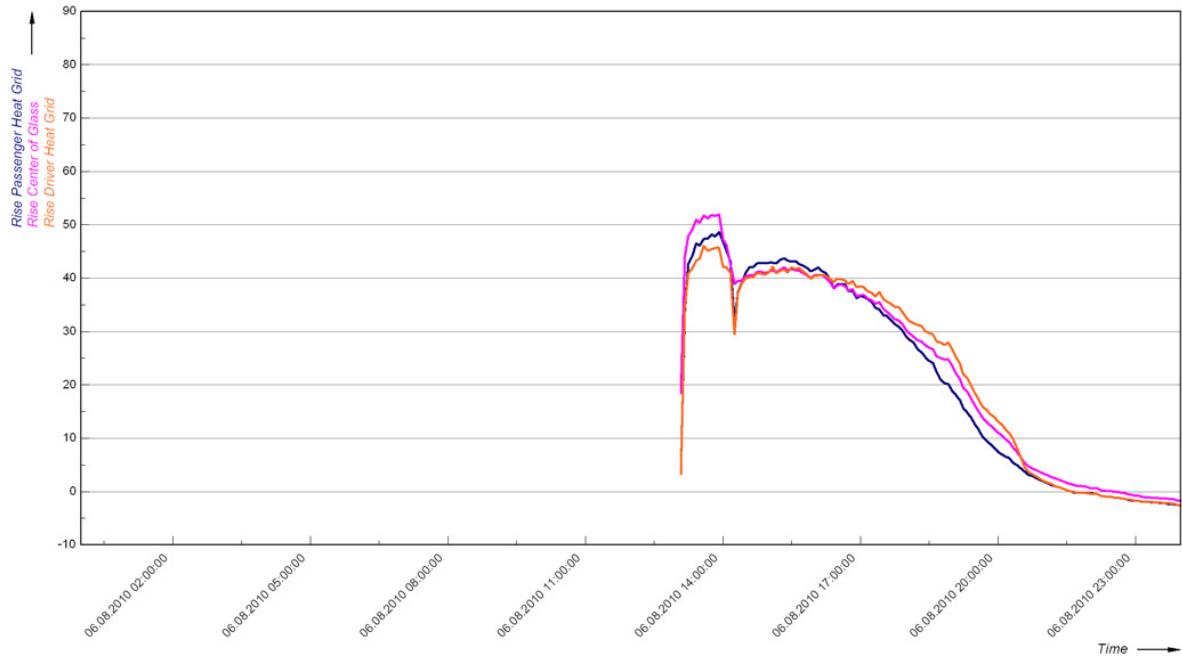
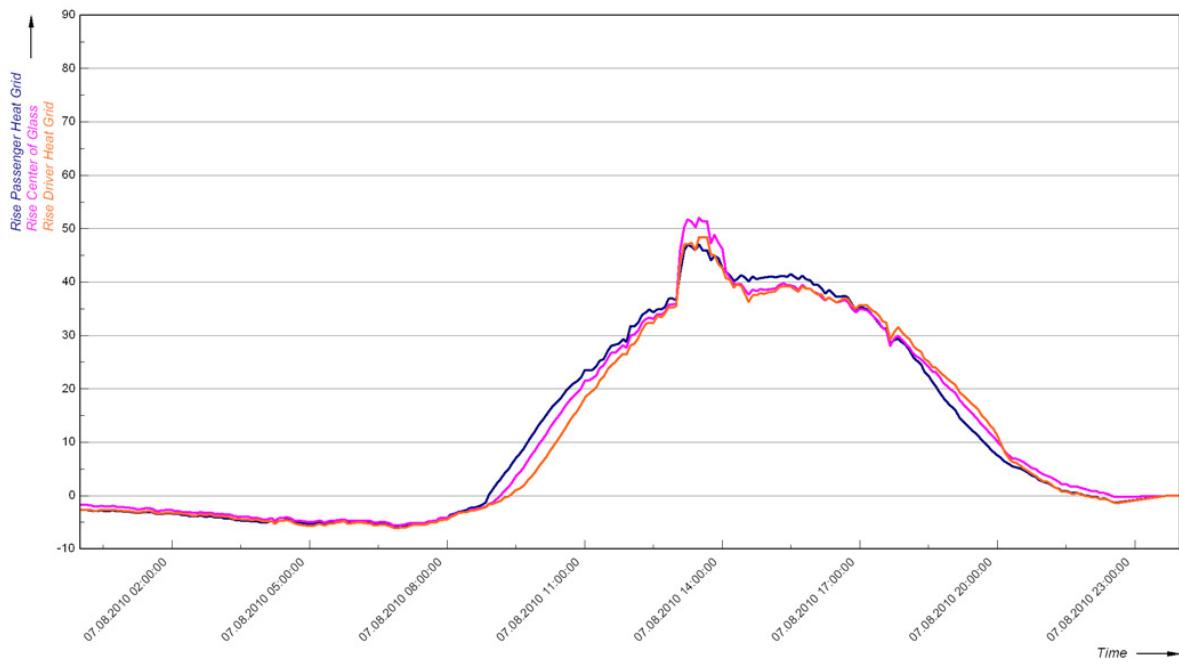
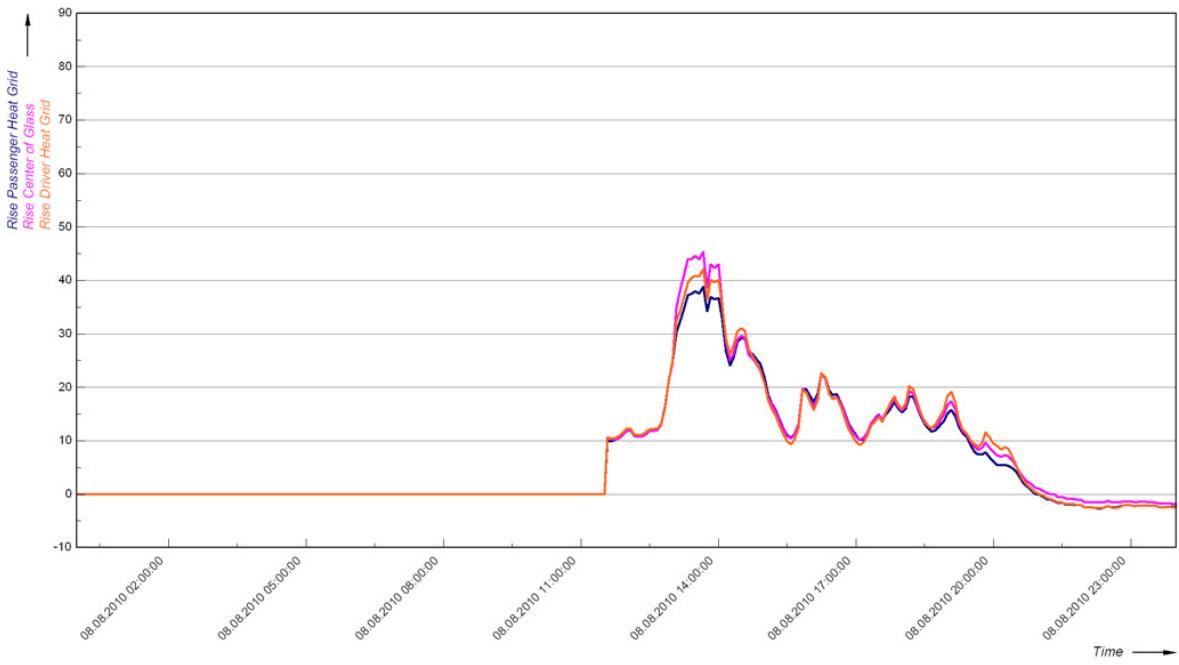


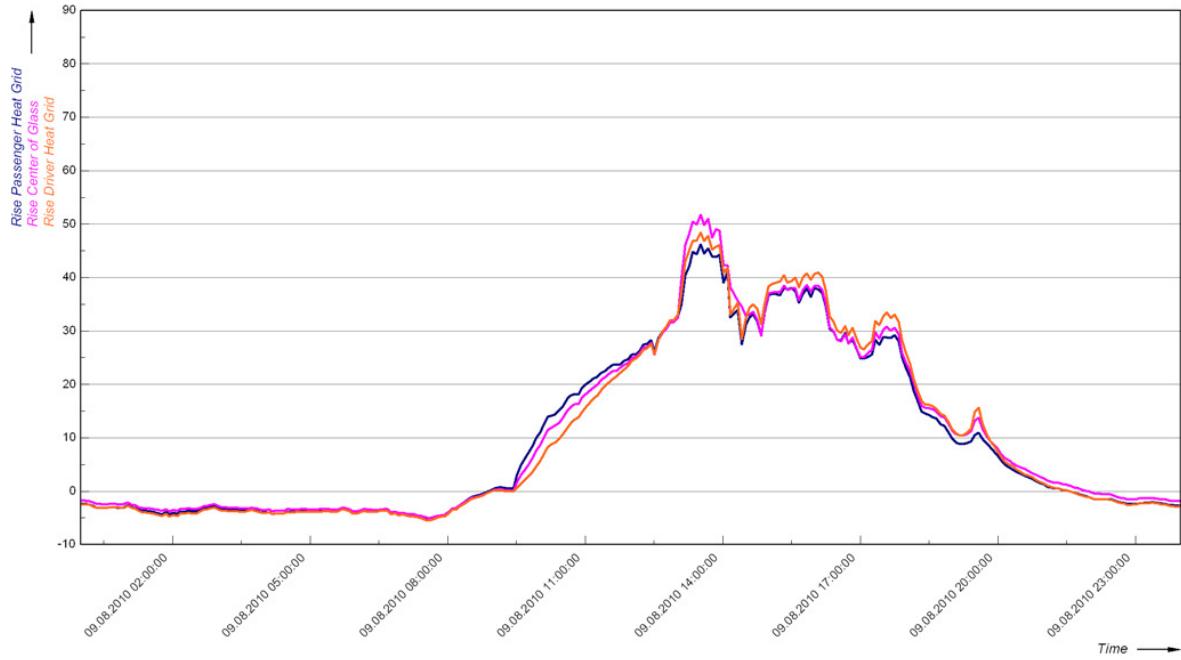
Figure 61: VW Eos - Rise - 06.08.2010



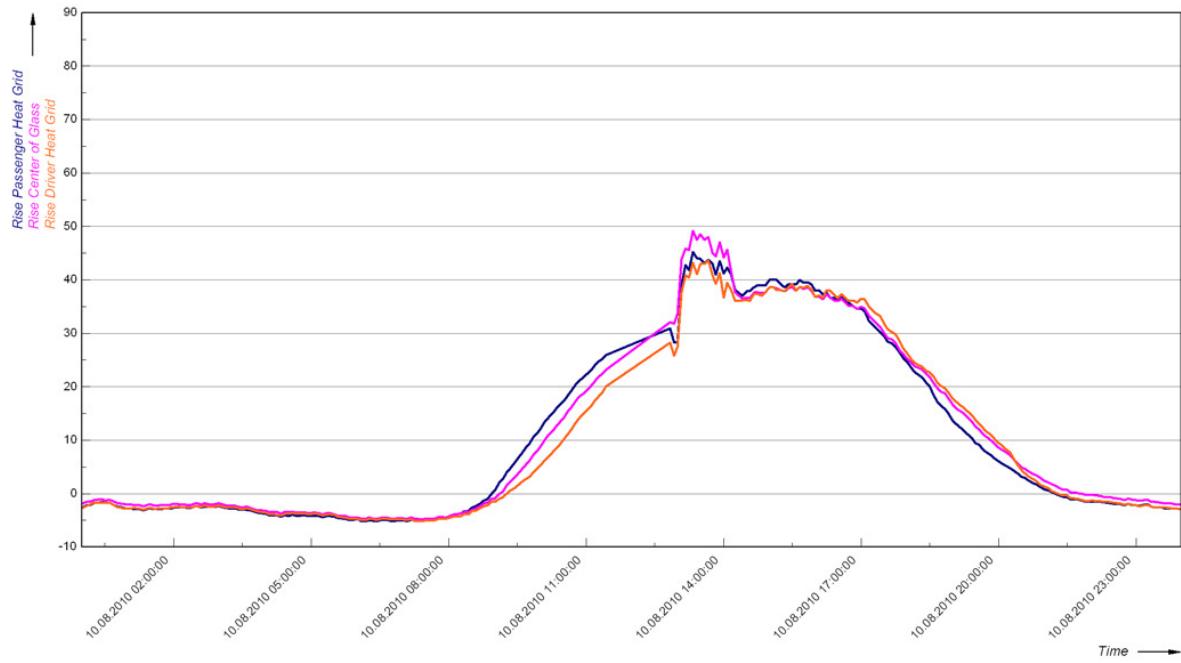
**Figure 62: VW Eos - Rise - 07.08.2010**



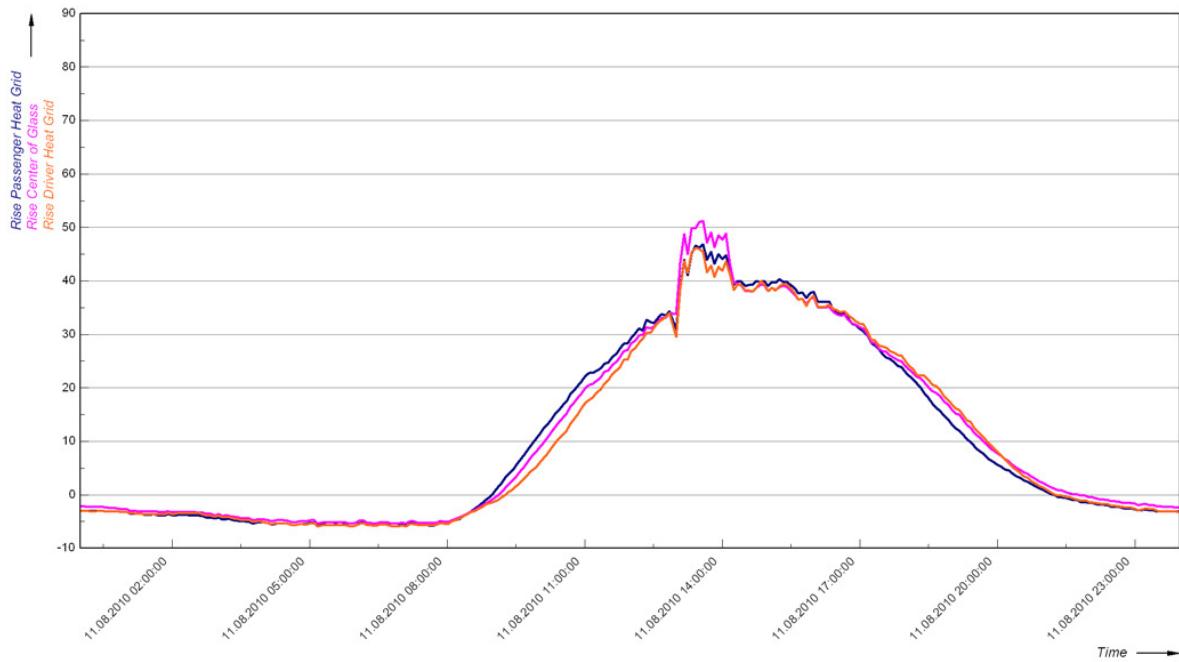
**Figure 63: VW Eos - Rise - 08.08.2010**



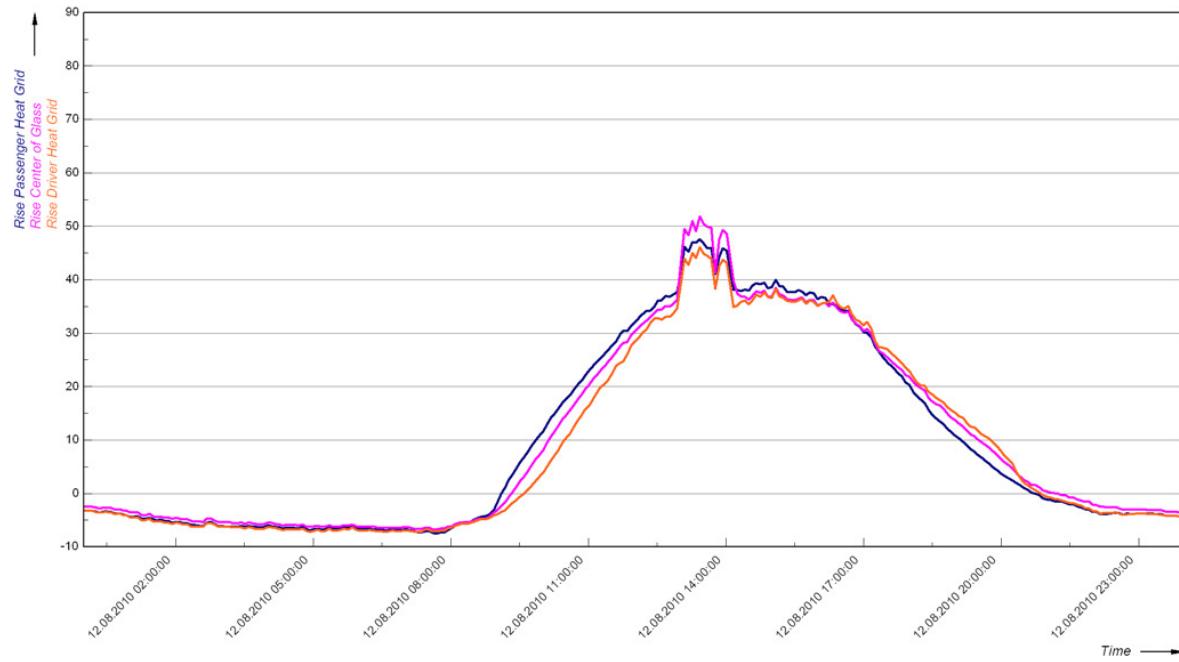
**Figure 64: VW Eos - Rise - 09.08.2010**



**Figure 65: VW Eos - Rise - 10.08.2010**



**Figure 66: VW Eos - Rise - 11.08.2010**



**Figure 67: VW Eos - Rise - 12.08.2010**

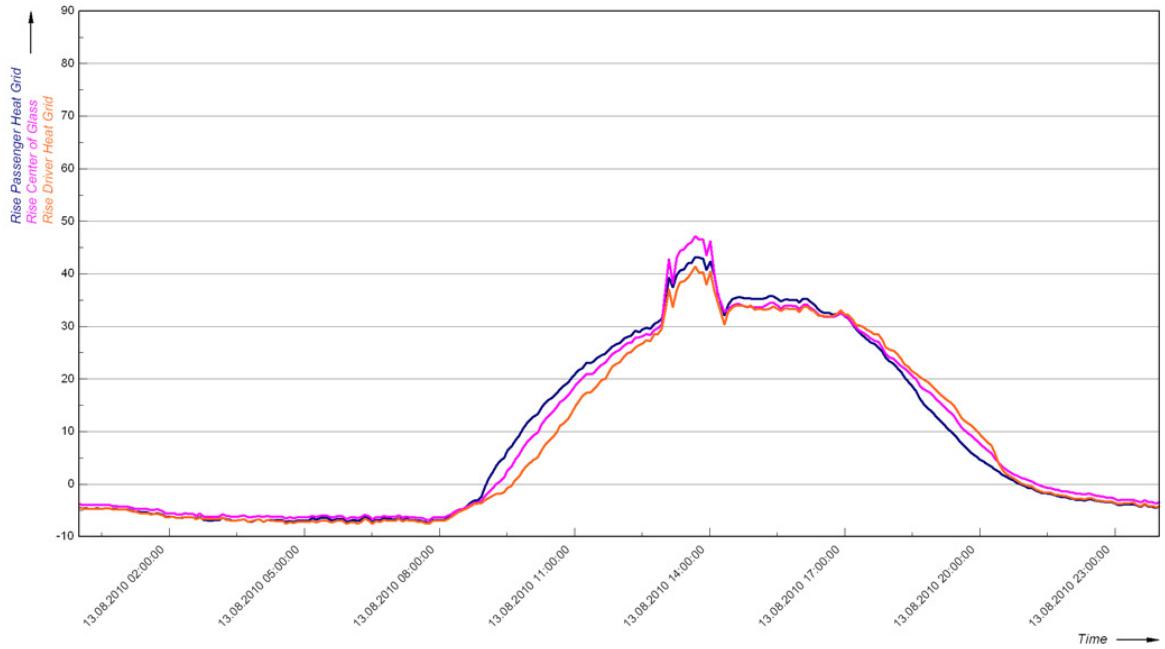


Figure 68: VW Eos - Rise - 13.08.2010

## ii. Skoda Octavia

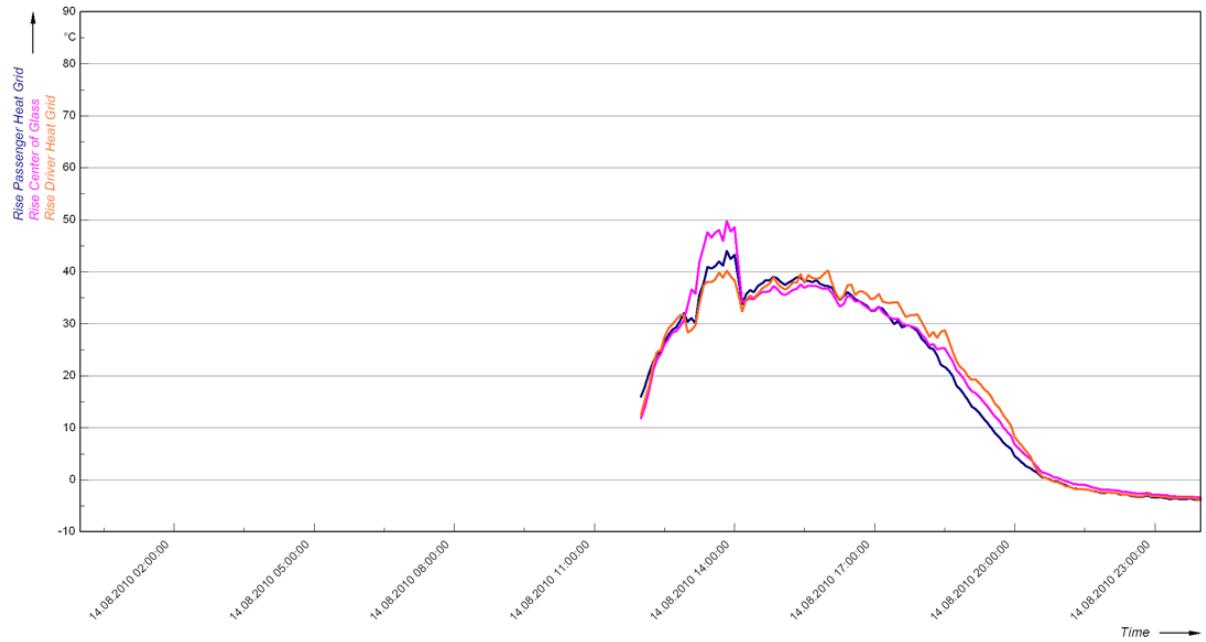
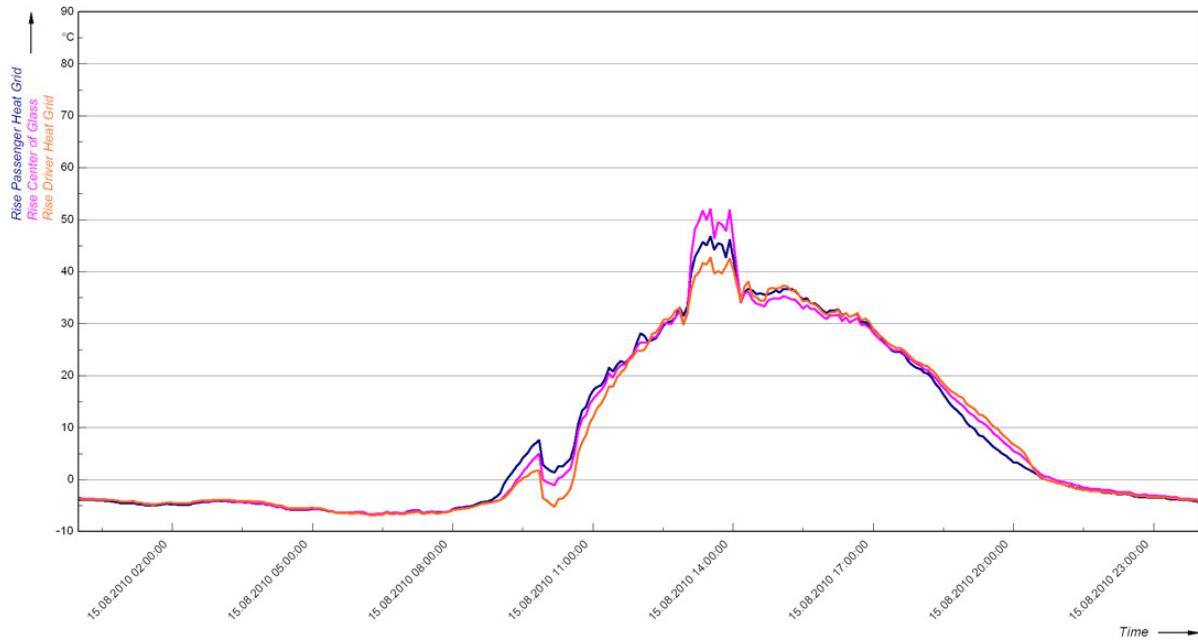
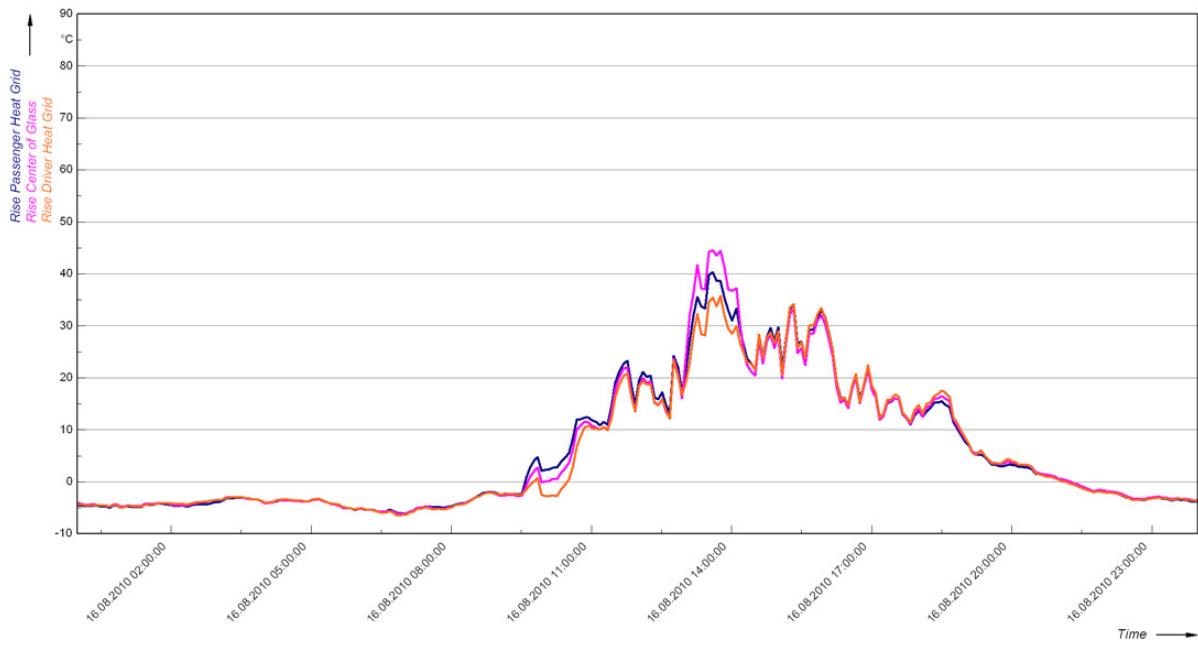


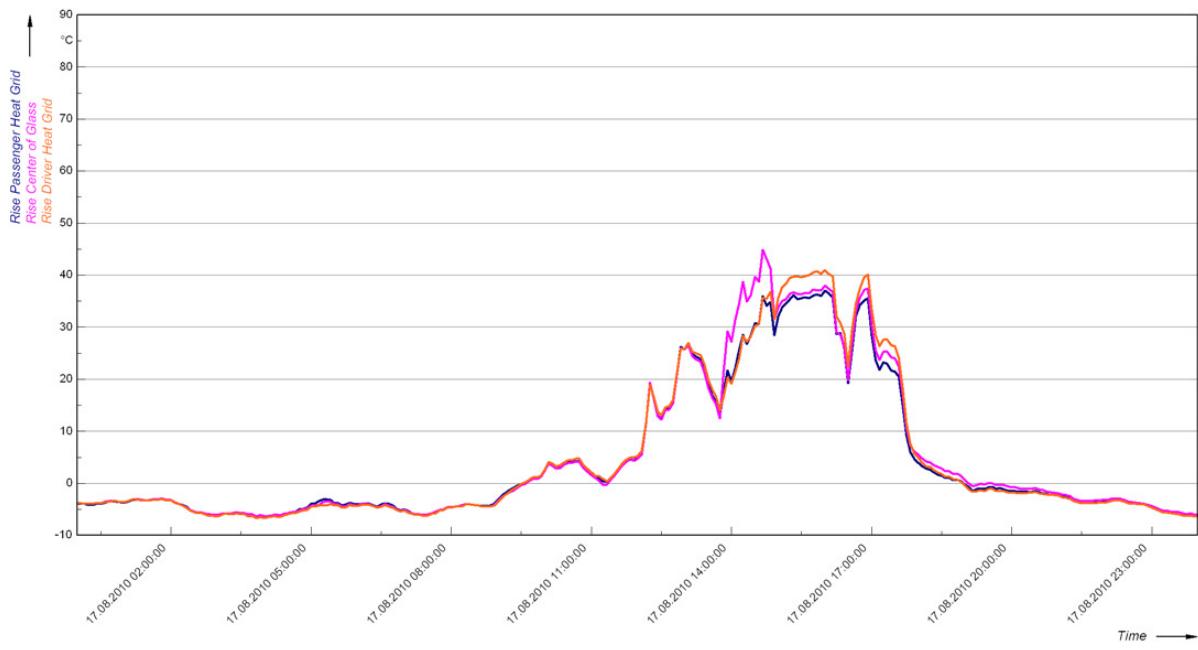
Figure 69: Skoda Octavia - Rise - 14.08.2010



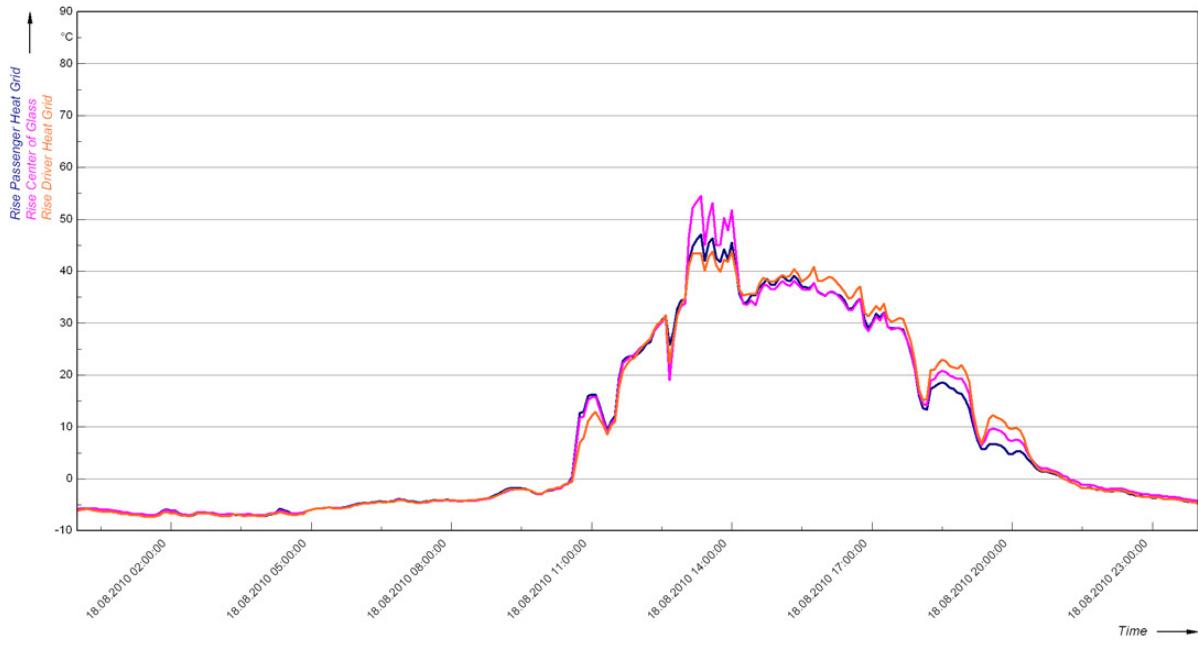
**Figure 70: Skoda Octavia - Rise - 15.08.2010**



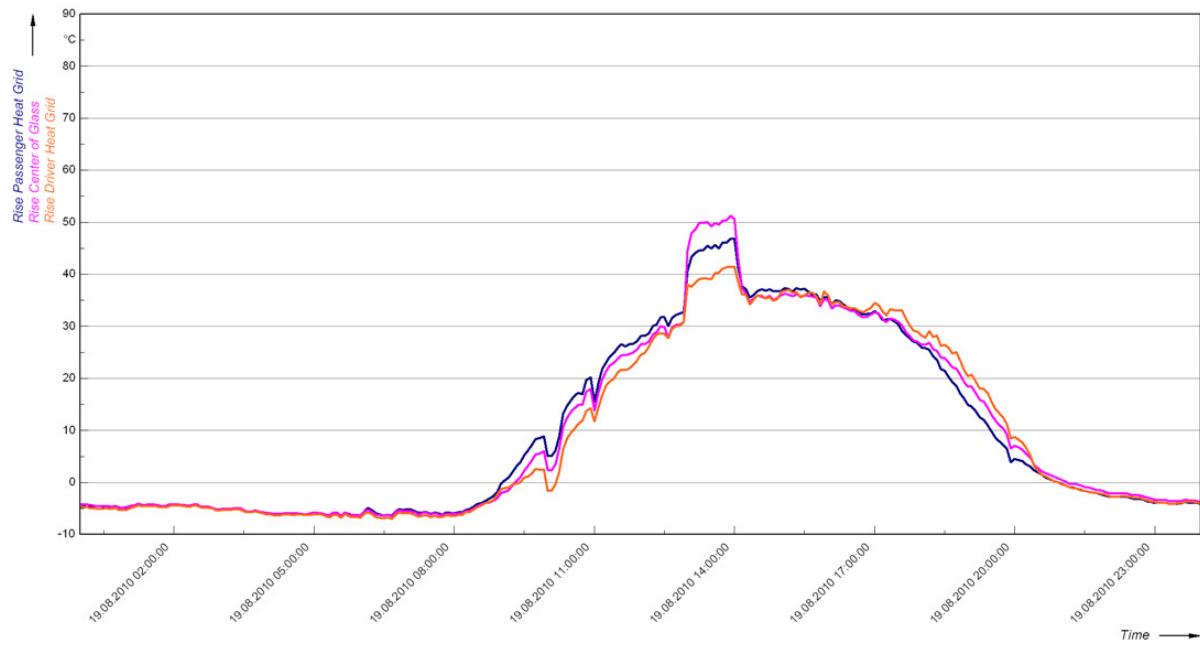
**Figure 71: Skoda Octavia - Rise - 16.08.2010**



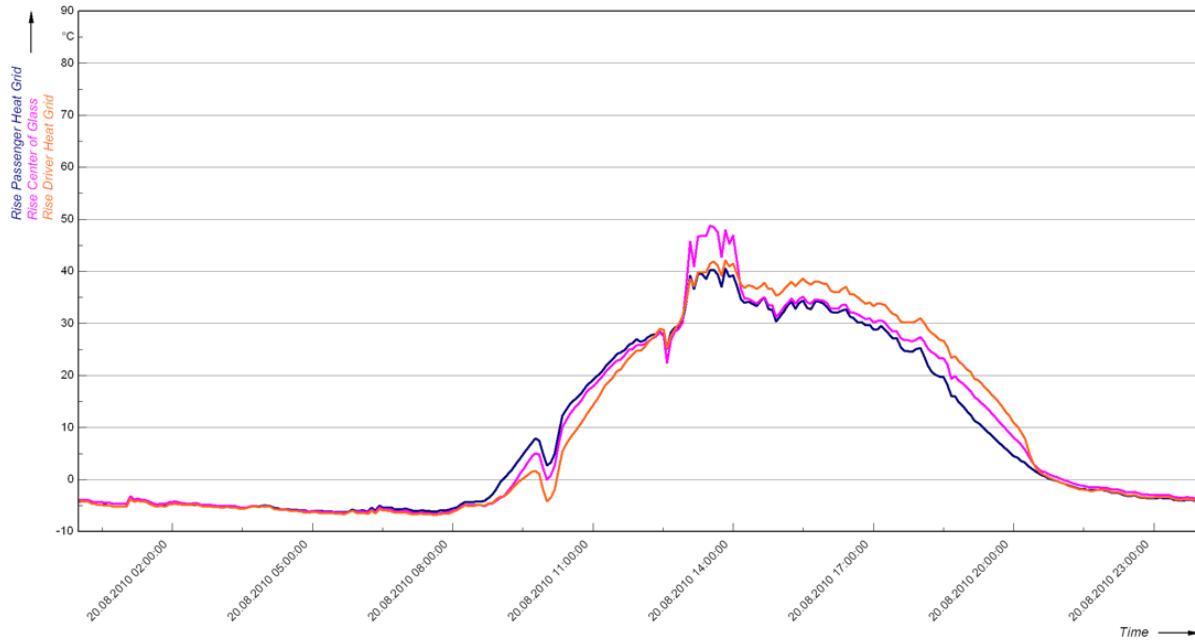
**Figure 72: Skoda Octavia - Rise - 17.08.2010**



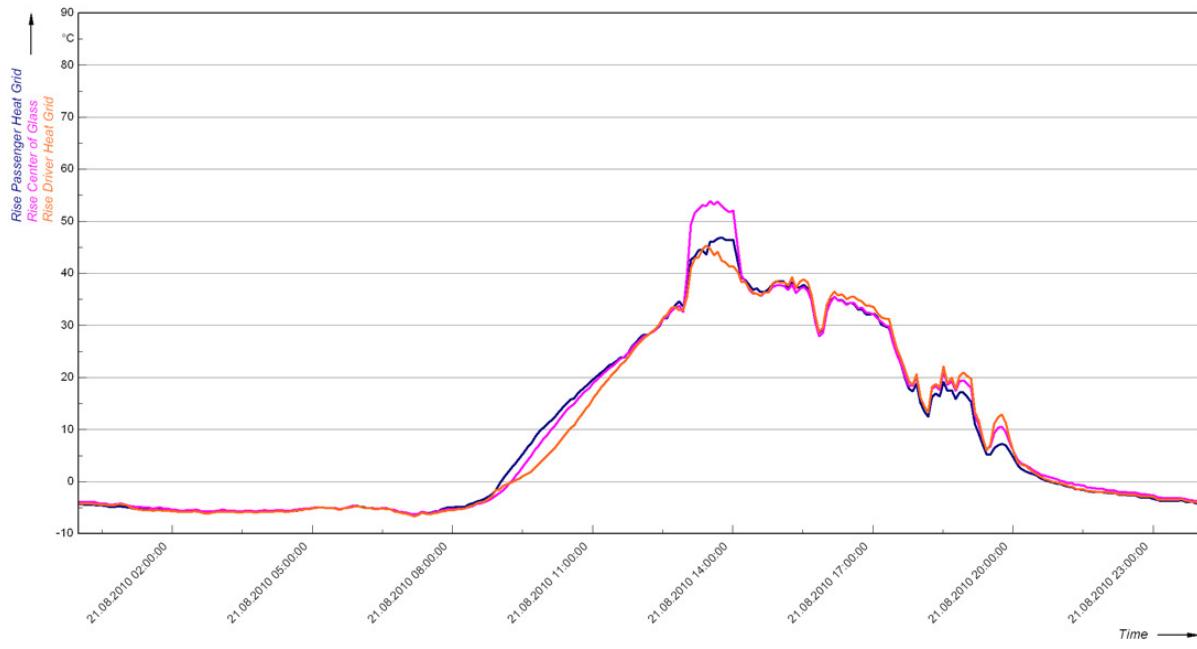
**Figure 73: Skoda Octavia - Rise - 18.08.2010**



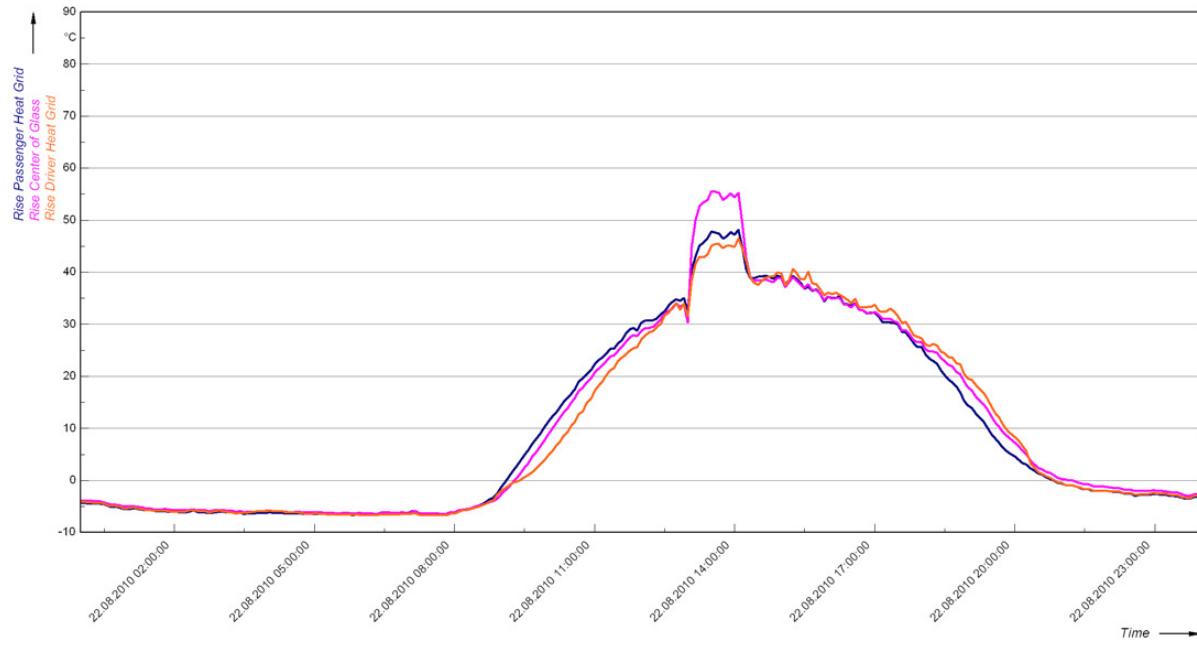
**Figure 74: Skoda Octavia - Rise - 19.08.2010**



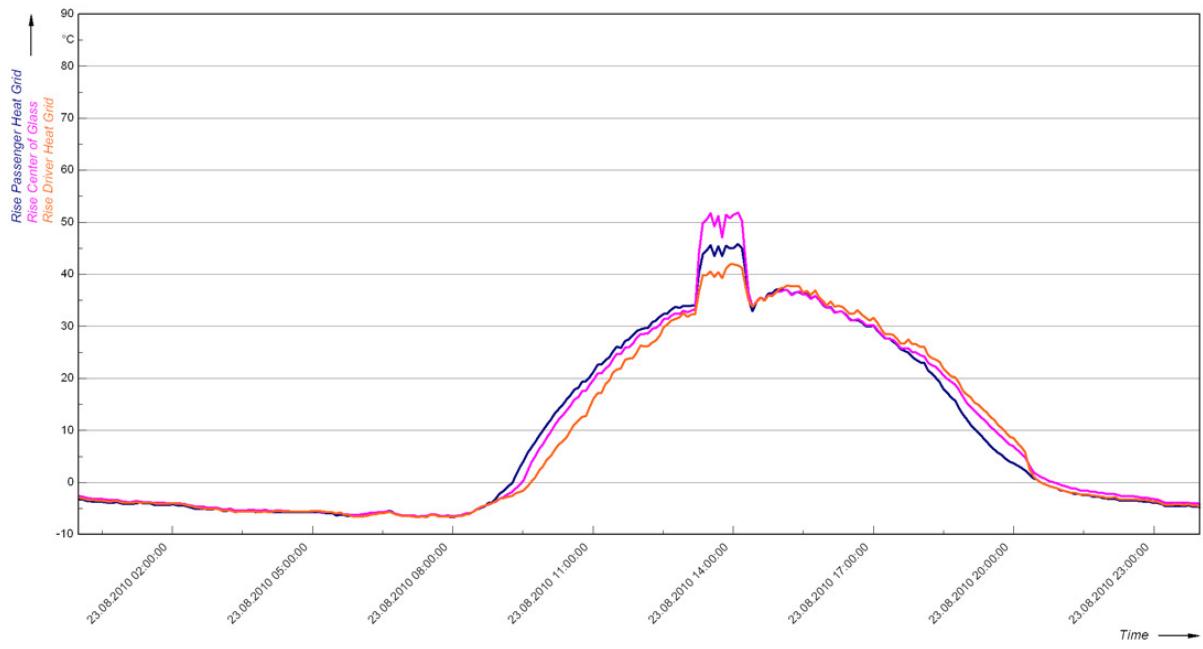
**Figure 75: Skoda Octavia - Rise - 20.08.2010**



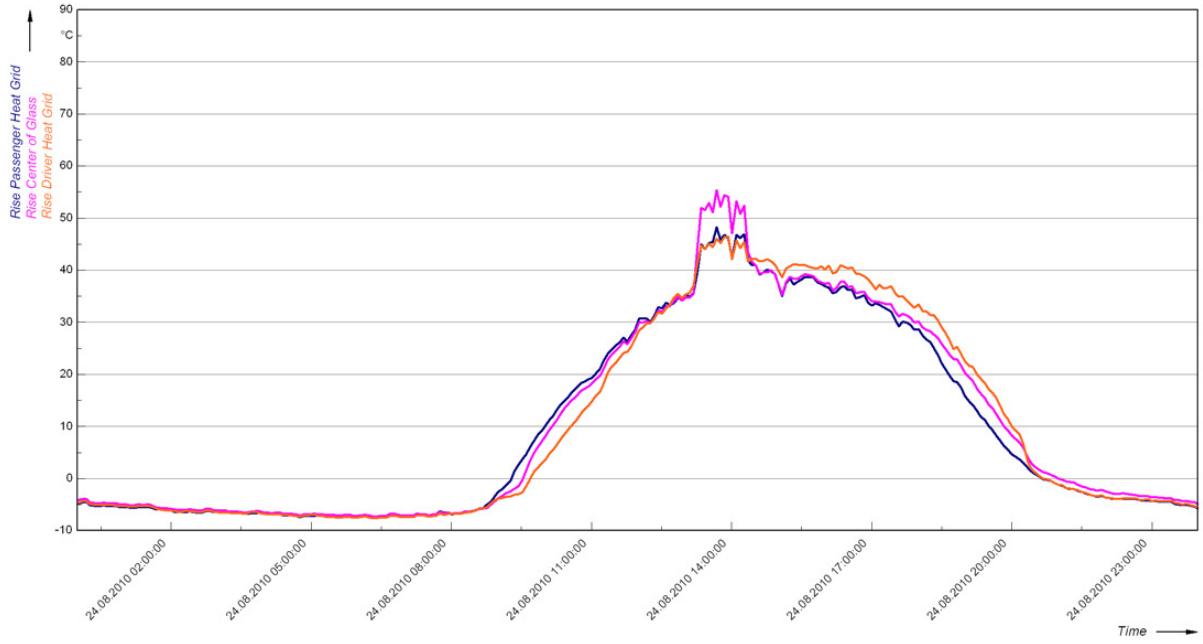
**Figure 76: Skoda Octavia - Rise - 21.08.2010**



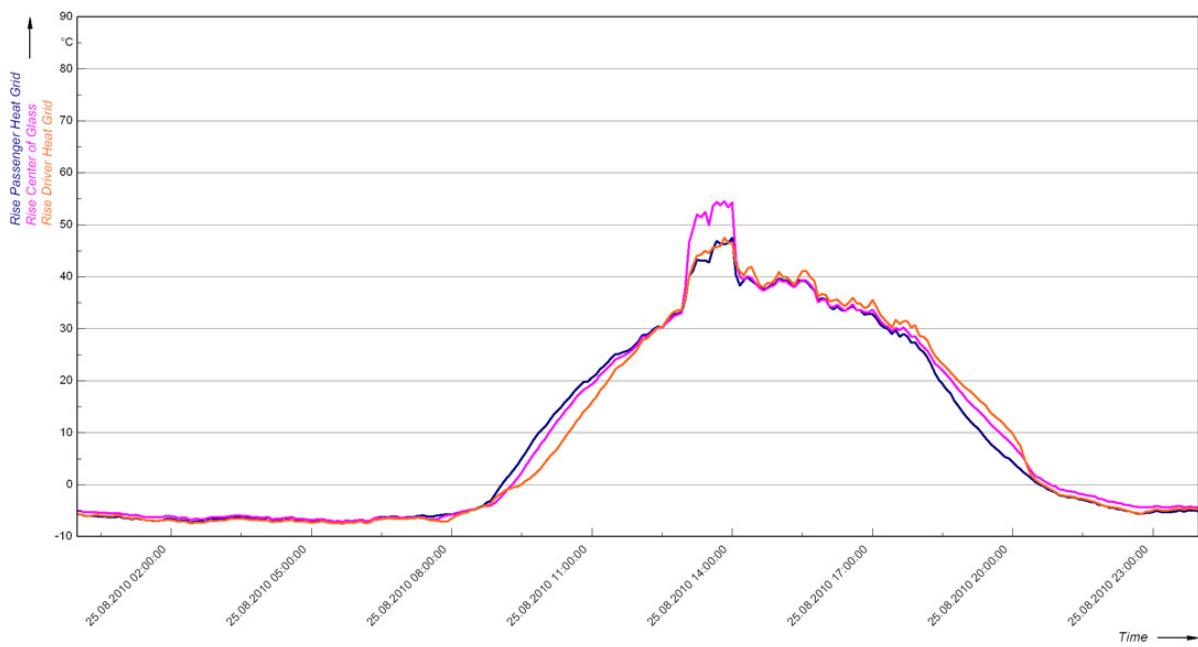
**Figure 77: Skoda Octavia - Rise - 22.08.2010**



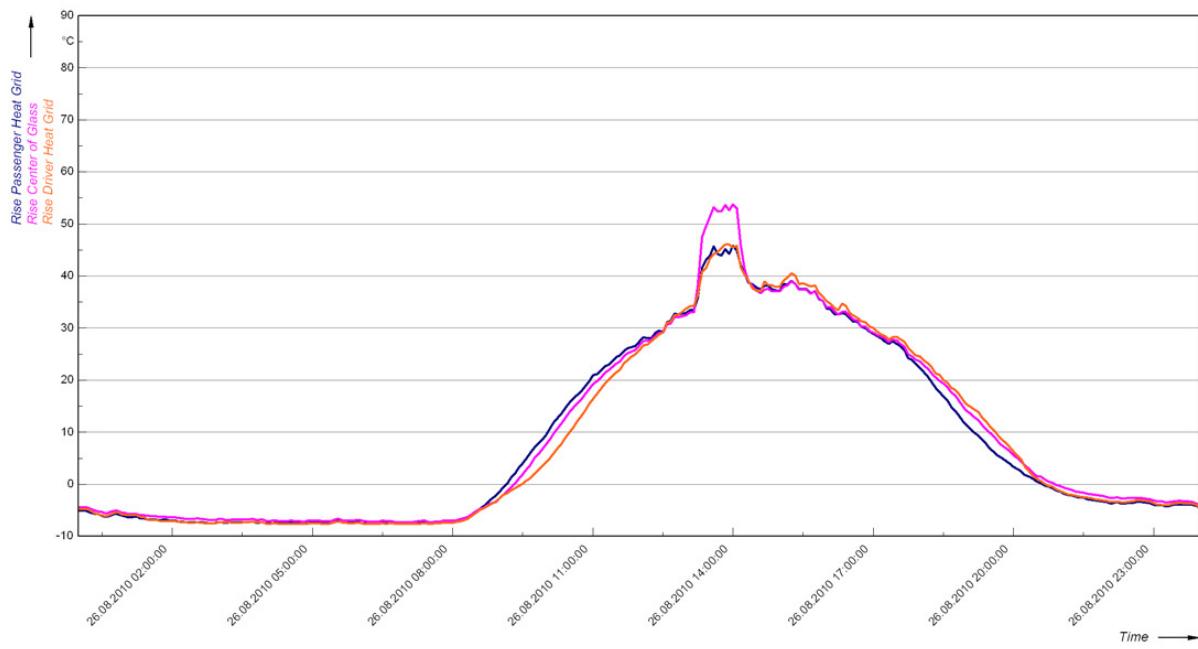
**Figure 78: Skoda Octavia - Rise - 23.08.2010**



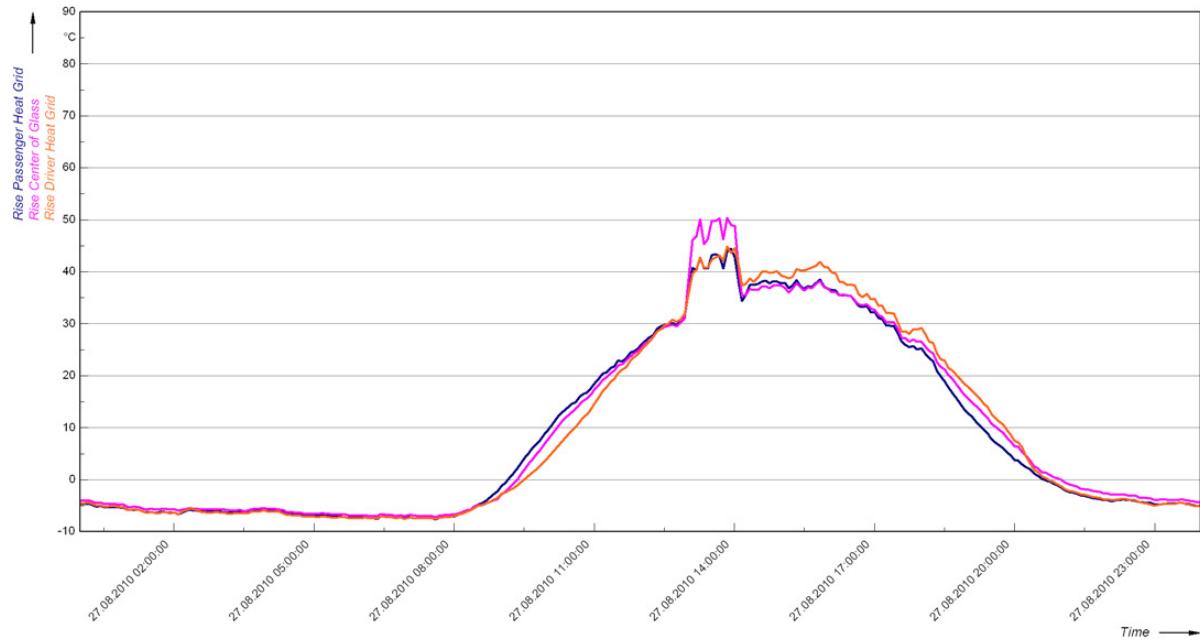
**Figure 79: Skoda Octavia - Rise - 24.08.2010**



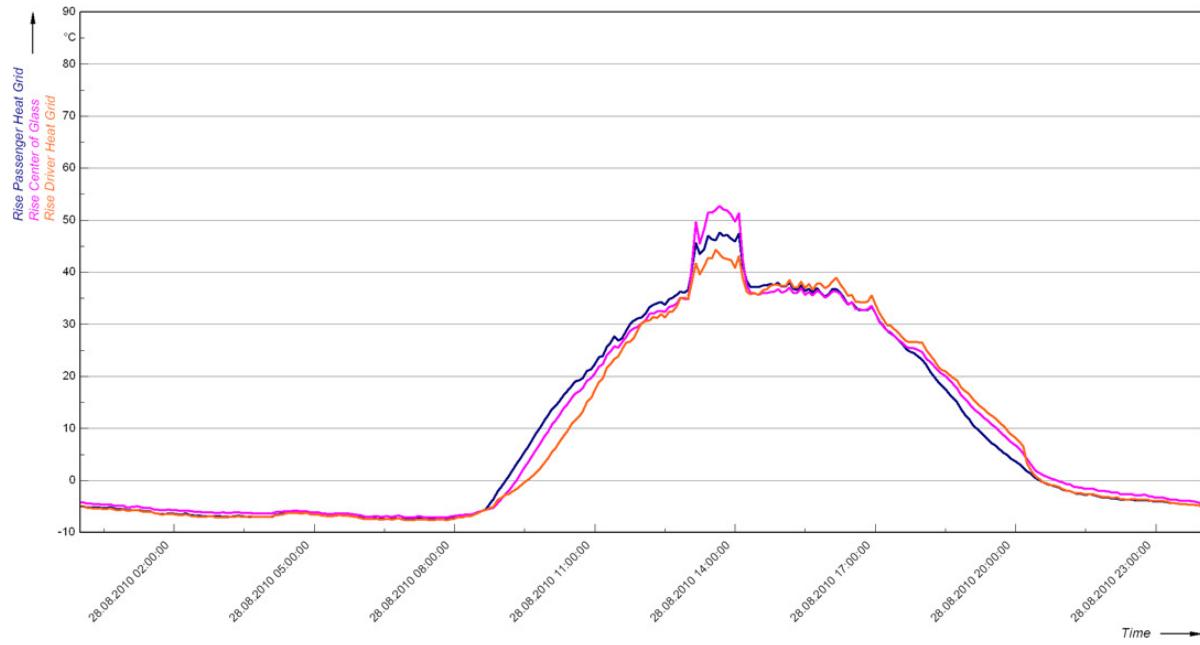
**Figure 80: Skoda Octavia - Rise - 25.08.2010**



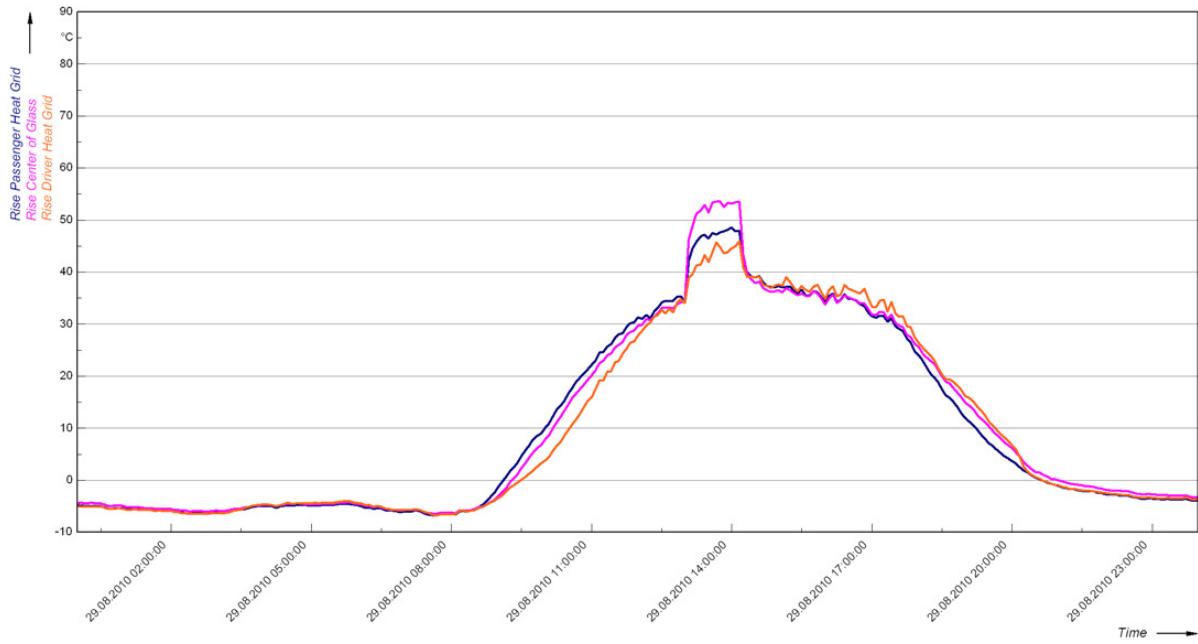
**Figure 81: Skoda Octavia - Rise - 26.08.2010**



**Figure 82: Skoda Octavia - Rise - 27.08.2010**

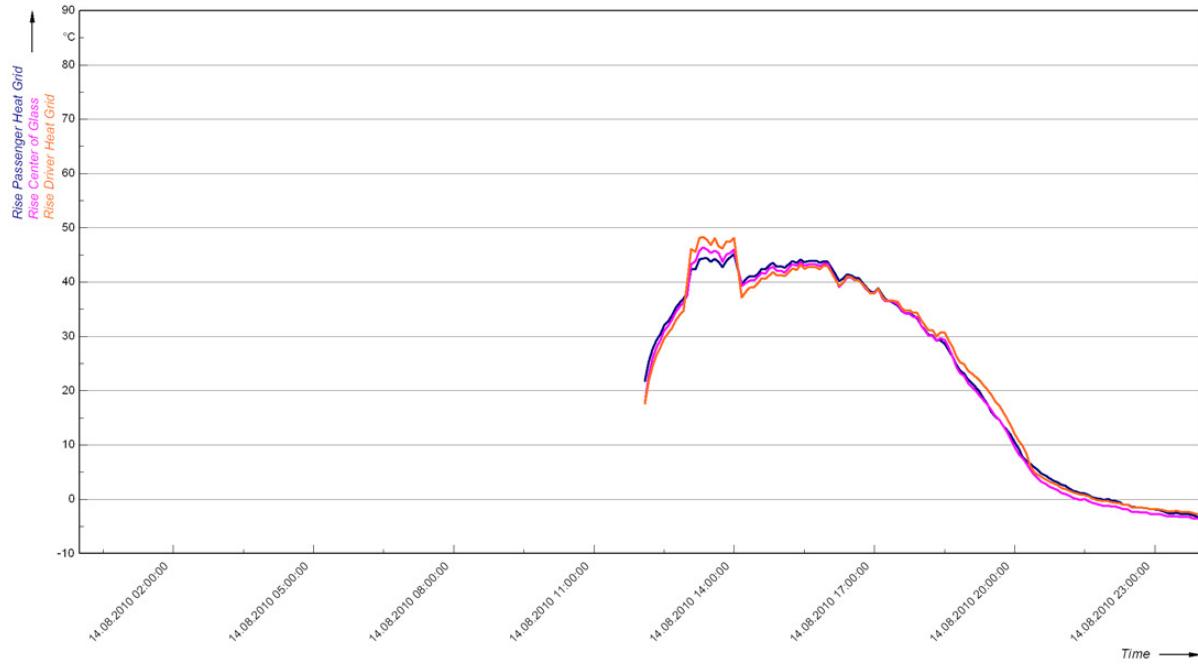


**Figure 83: Skoda Octavia - Rise - 28.08.2010**

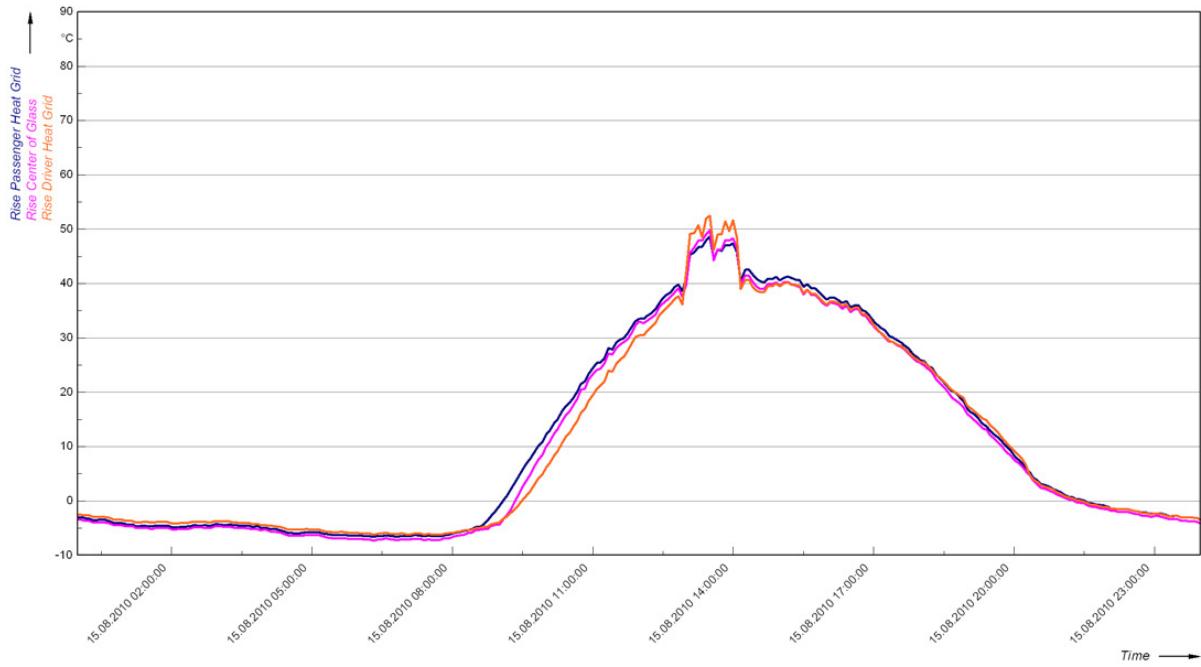


**Figure 84: Skoda Octavia - Rise - 29.08.2010**

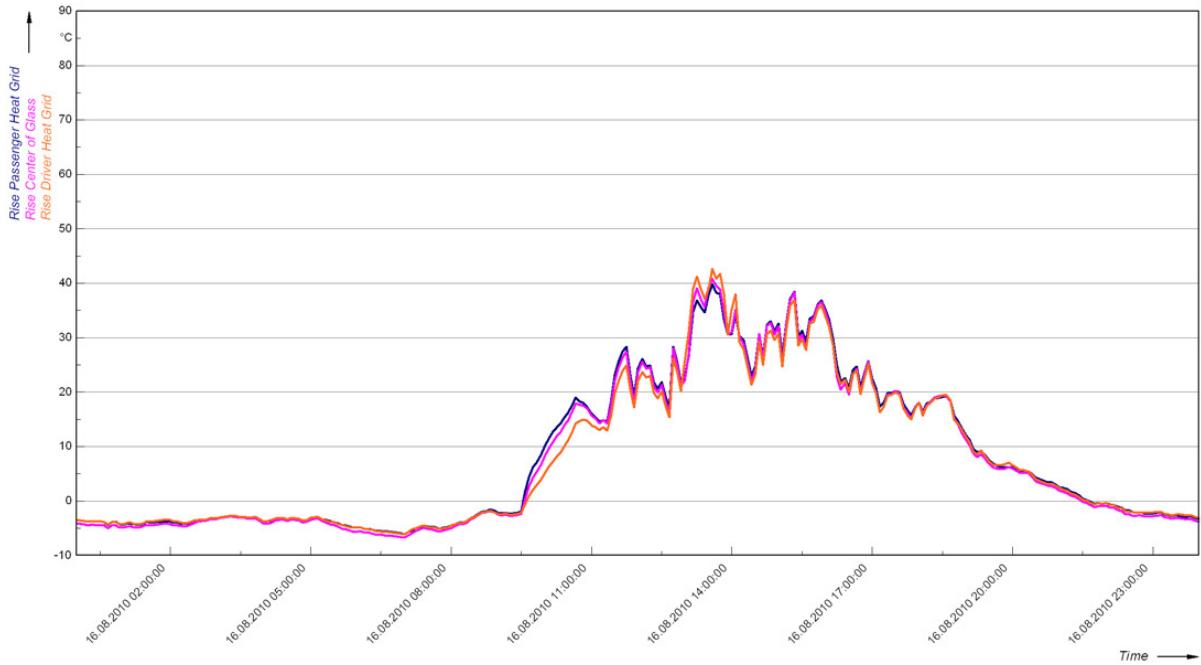
### iii. Audi TT



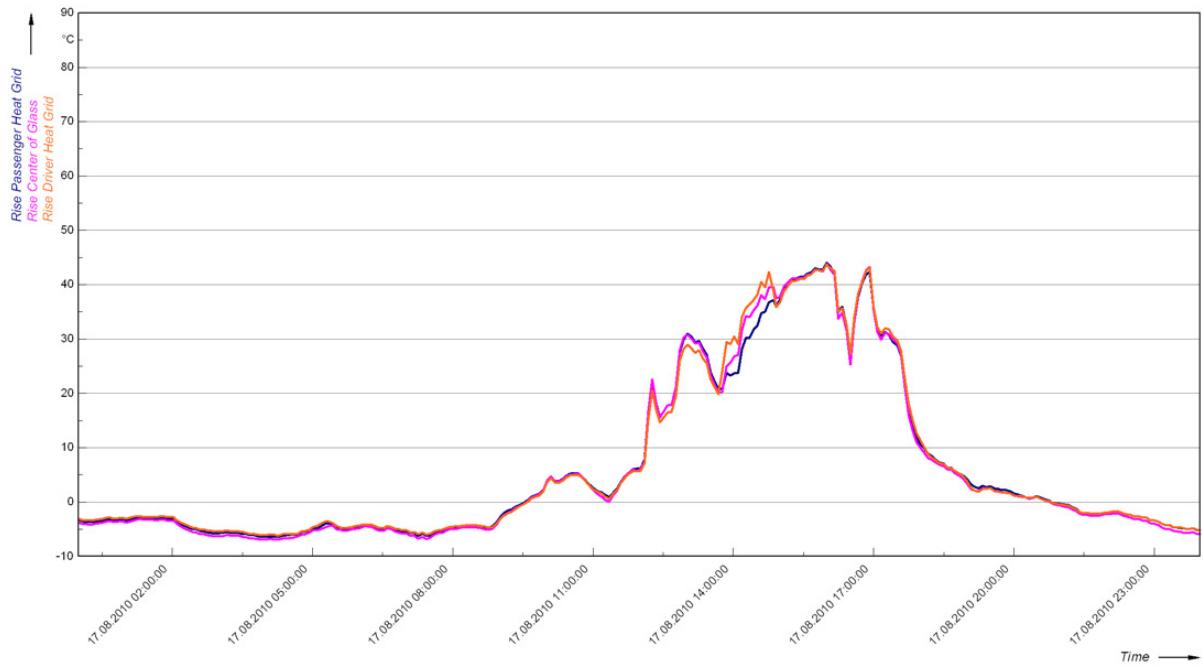
**Figure 85: Audi TT - Rise - 14.08.2010**



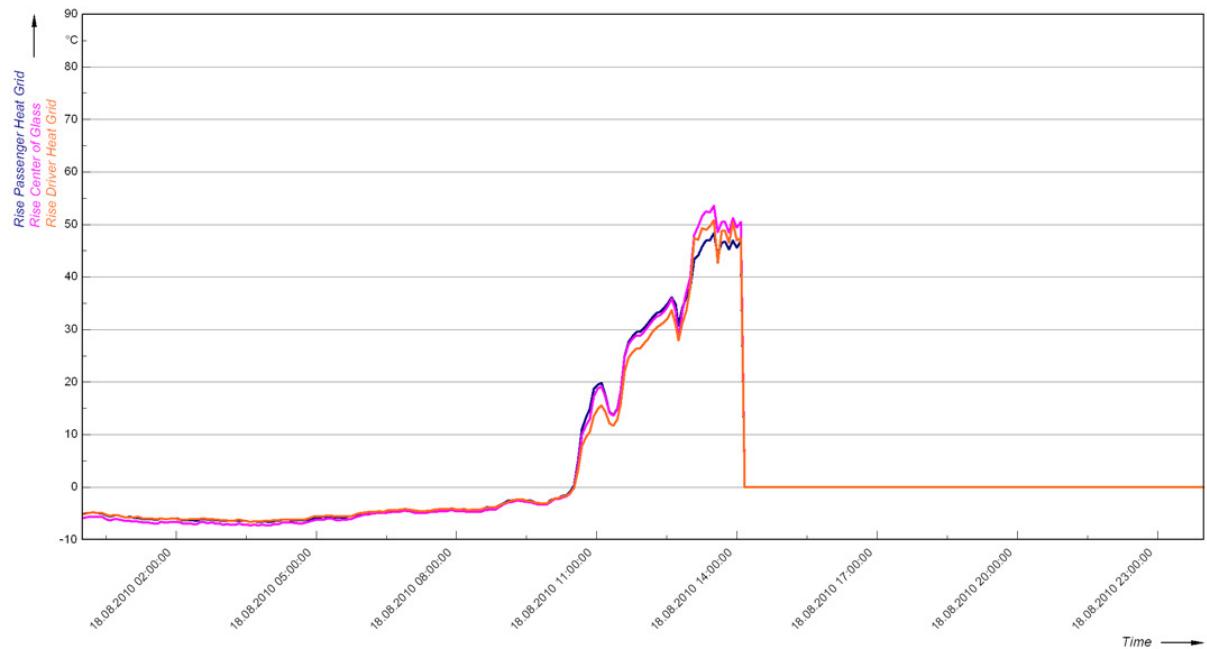
**Figure 86: Audi TT - Rise - 15.08.2010**



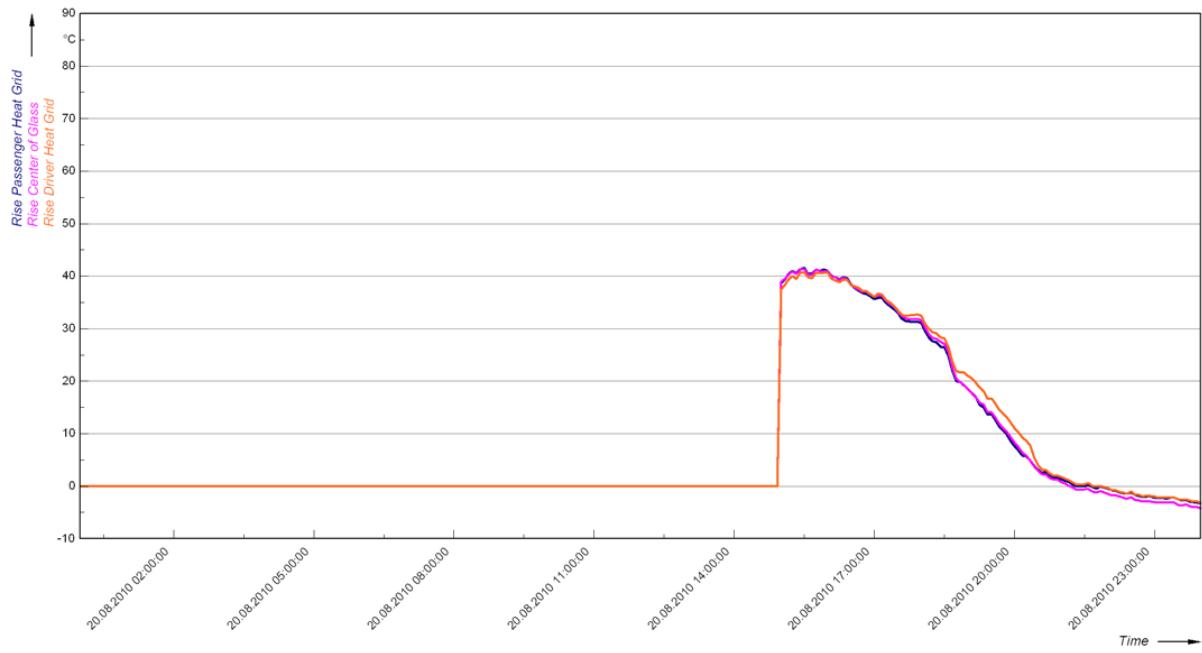
**Figure 87: Audi TT - Rise - 16.08.2010**



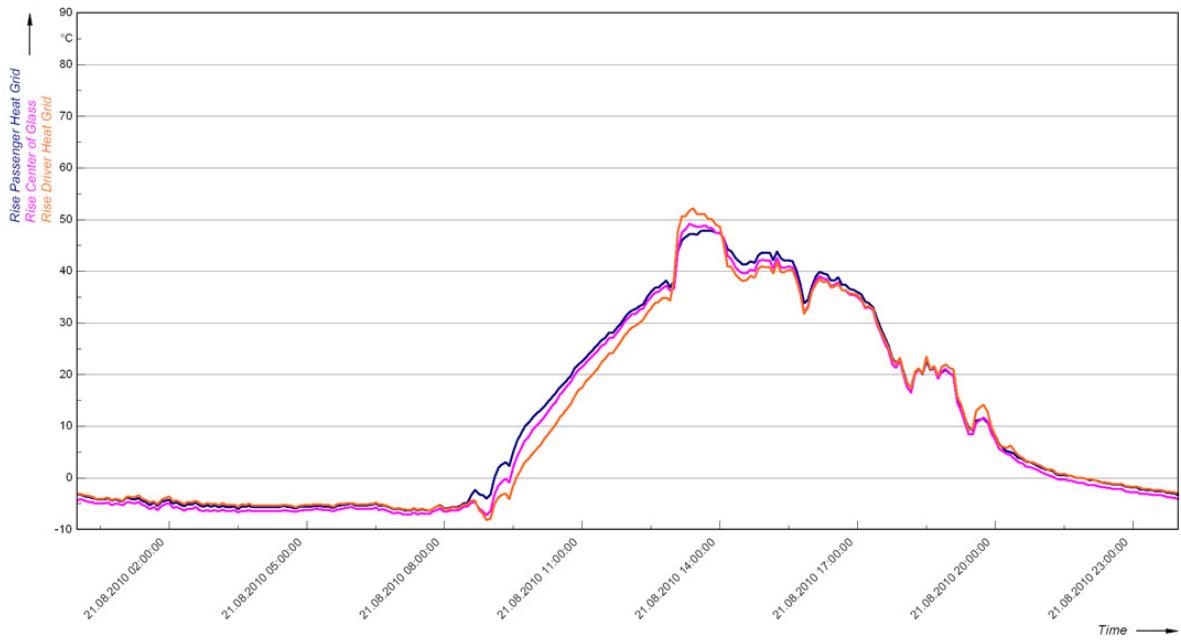
**Figure 88: Audi TT - Rise - 17.08.2010**



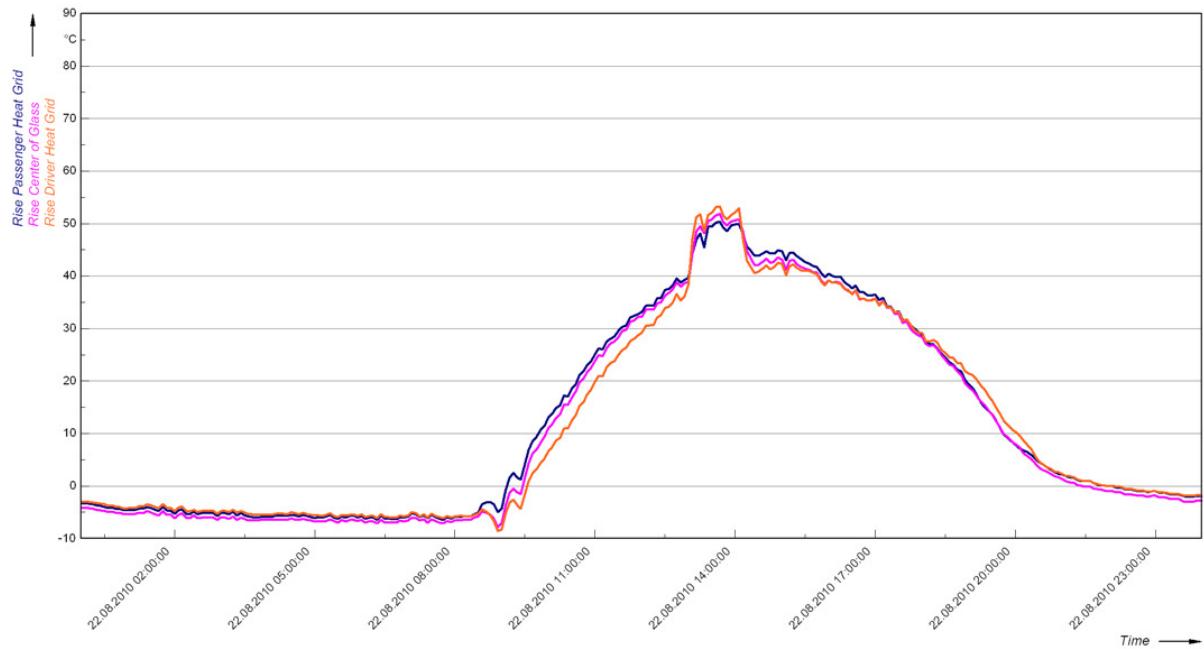
**Figure 89: Audi TT - Rise - 18.08.2010**



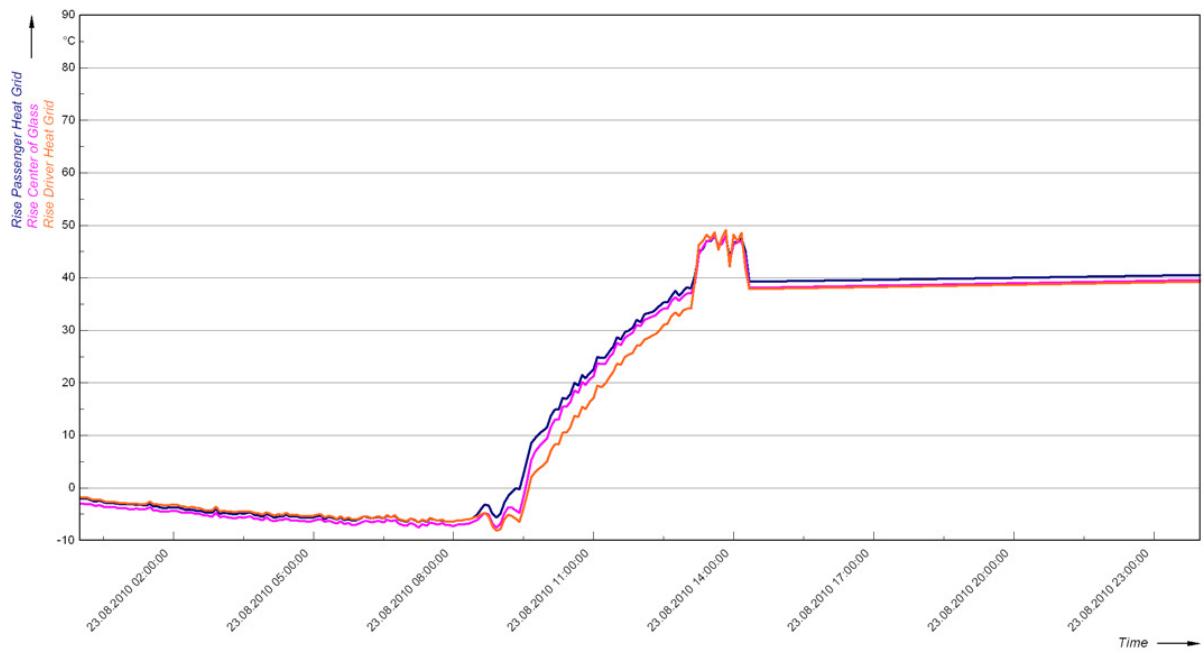
**Figure 90: Audi TT - Rise - 20.08.2010**



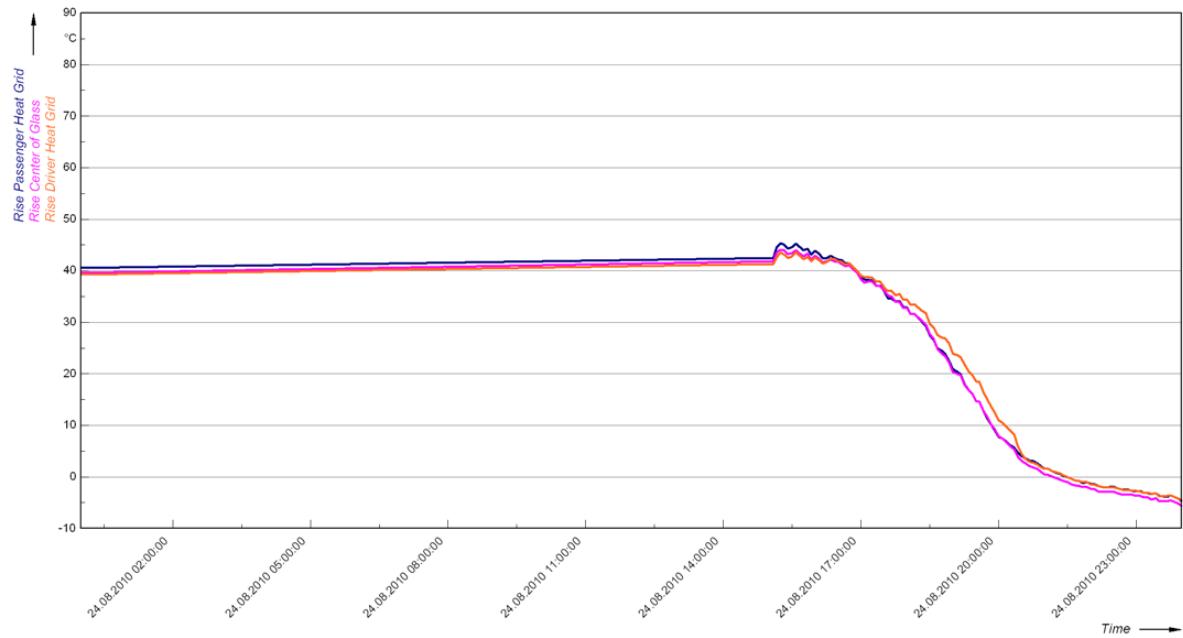
**Figure 91: Audi TT - Rise - 21.08.2010**



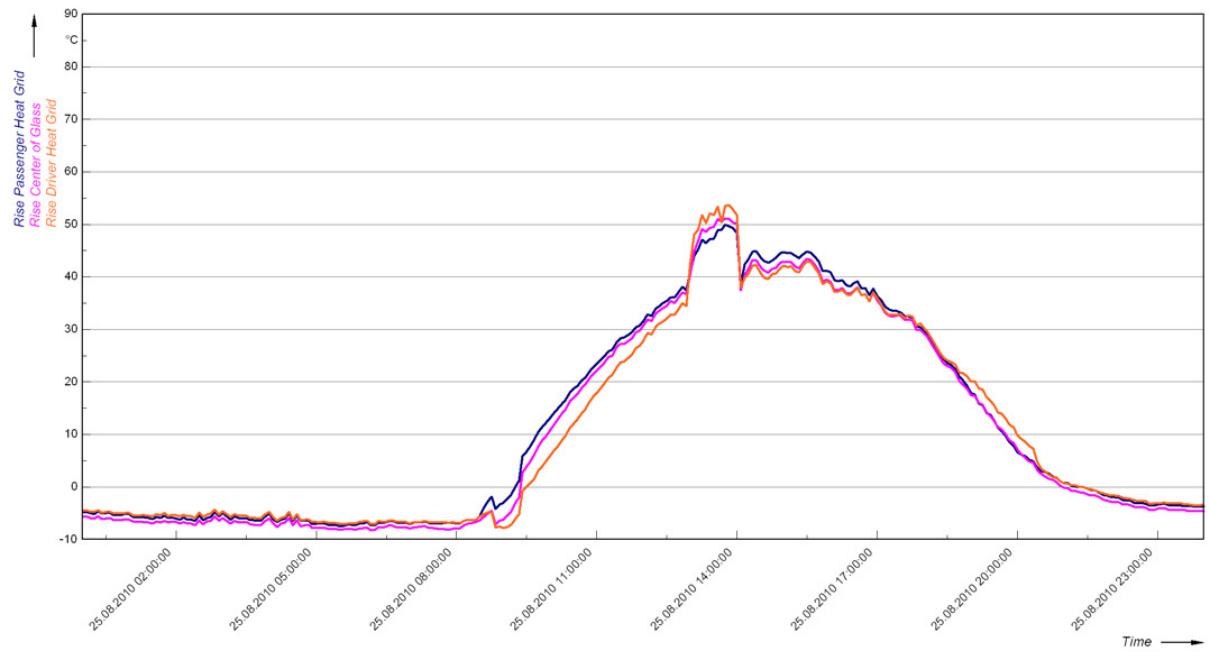
**Figure 92: Audi TT - Rise - 22.08.2010**



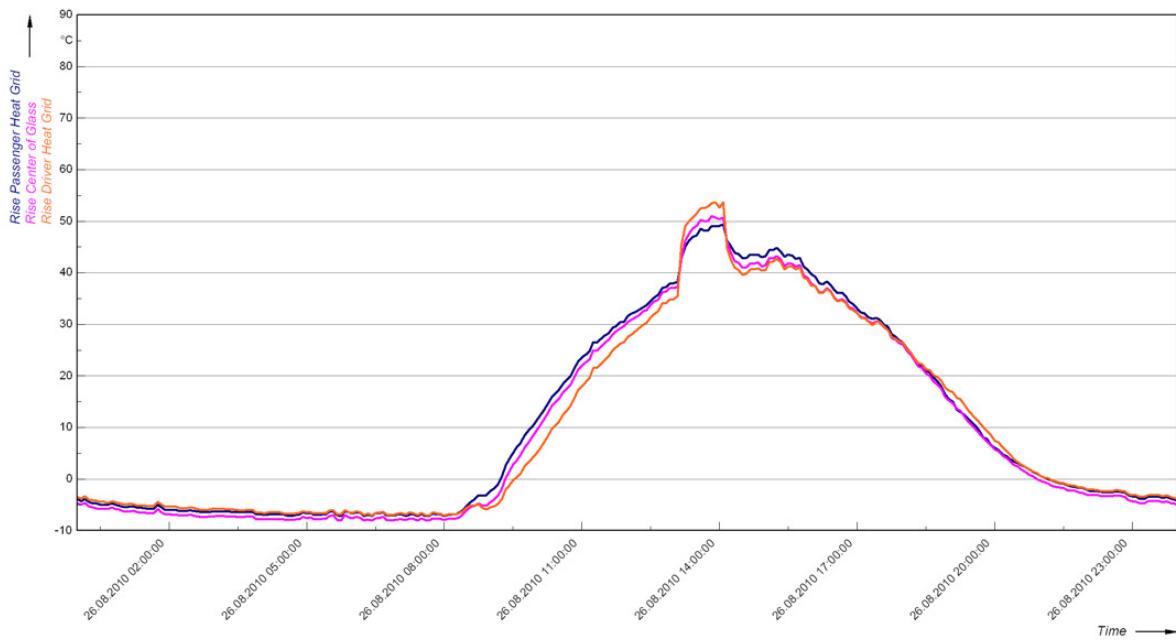
**Figure 93: Audi TT - Rise - 23.08.2010**



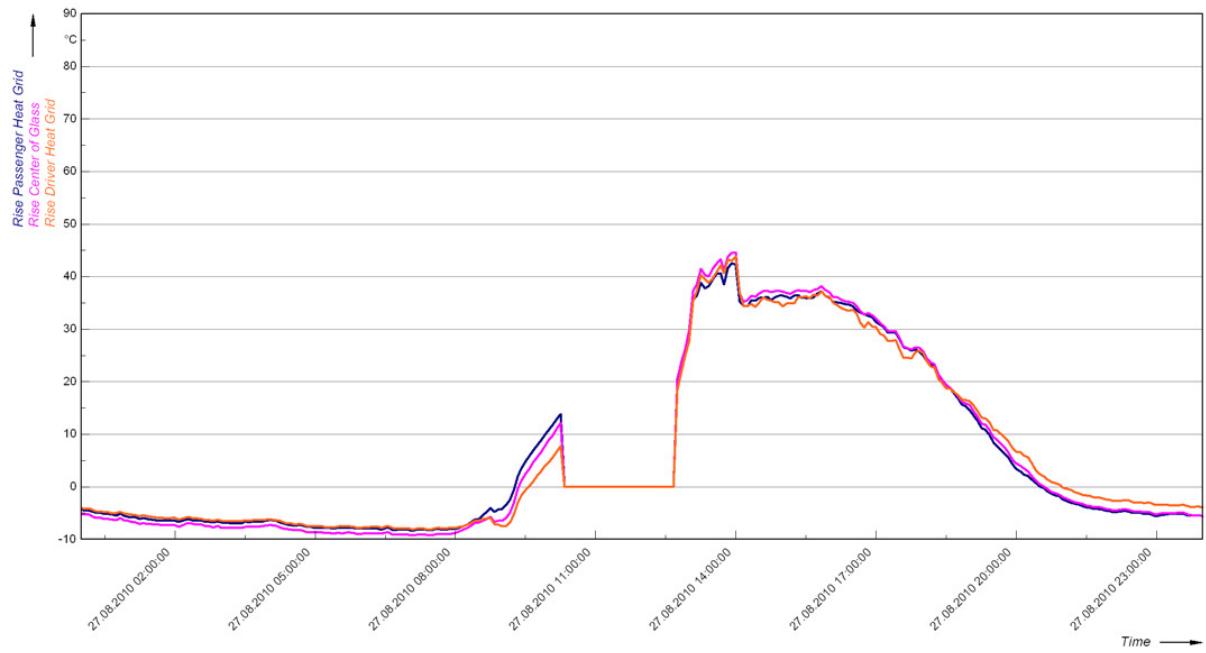
**Figure 94: Audi TT - Rise - 24.08.2010**



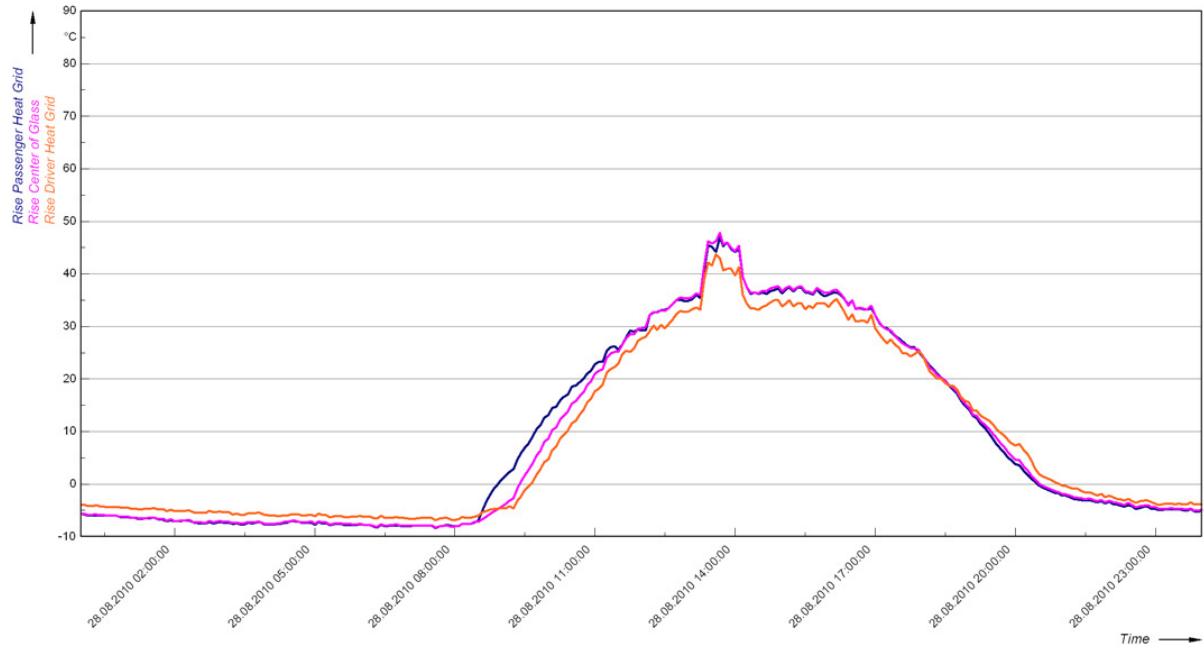
**Figure 95: Audi TT - Rise - 25.08.2010**



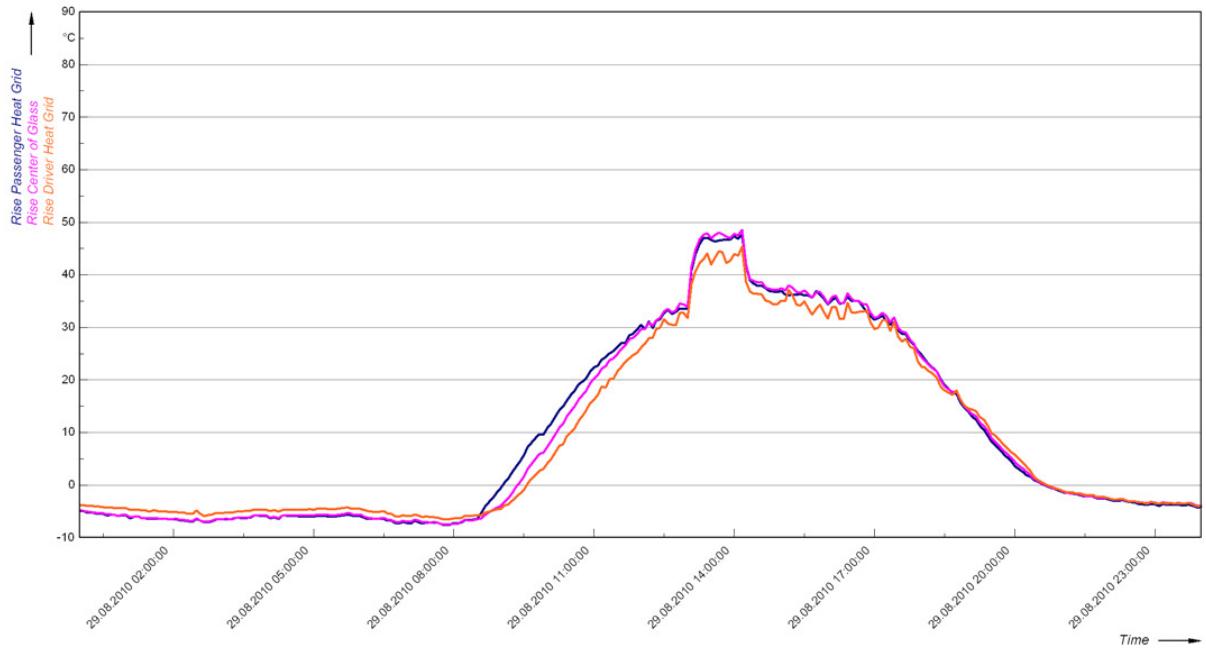
**Figure 96: Audi TT - Rise - 26.08.2010**



**Figure 97: Audi TT - Rise - 27.08.2010**



**Figure 98: Audi TT - Rise - 28.08.2010**



**Figure 99: Audi TT - Rise - 29.08.2010**

#### iv. Peugeot 407

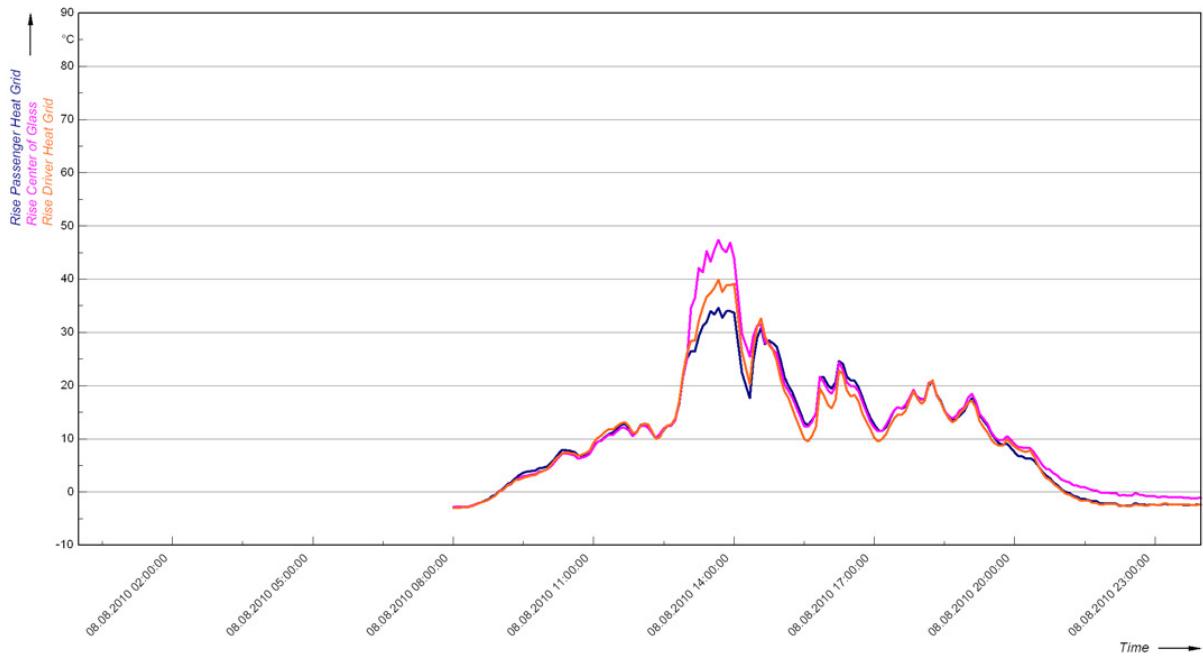


Figure 100: Peugeot 407 - Rise - 08.08.2010

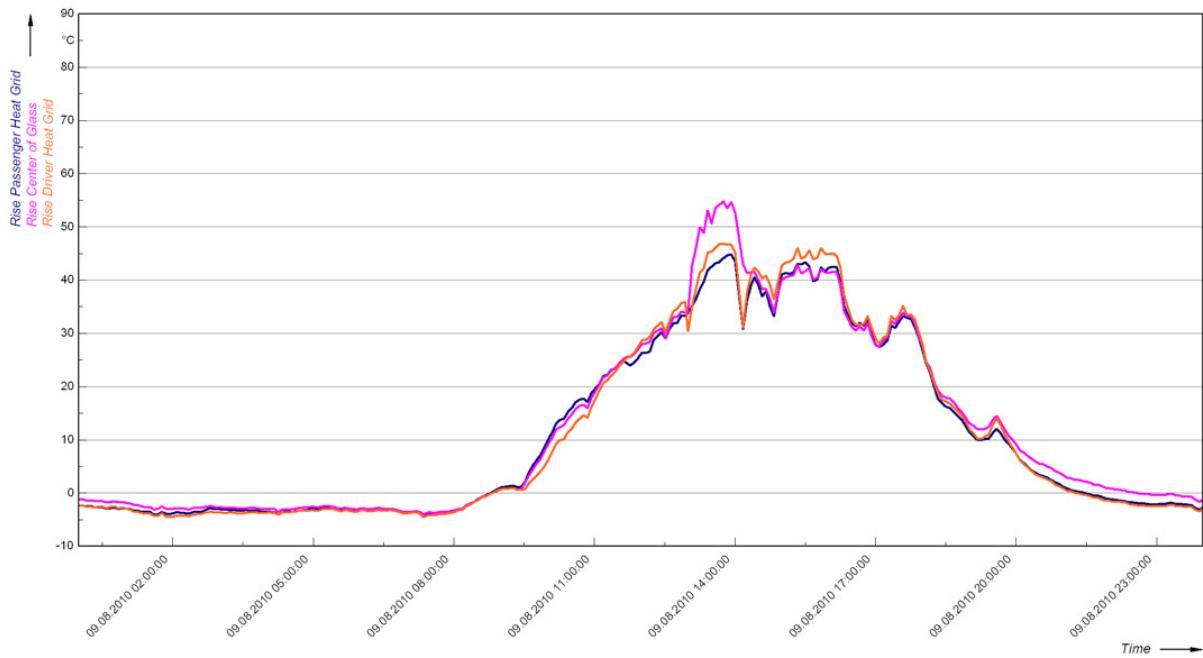
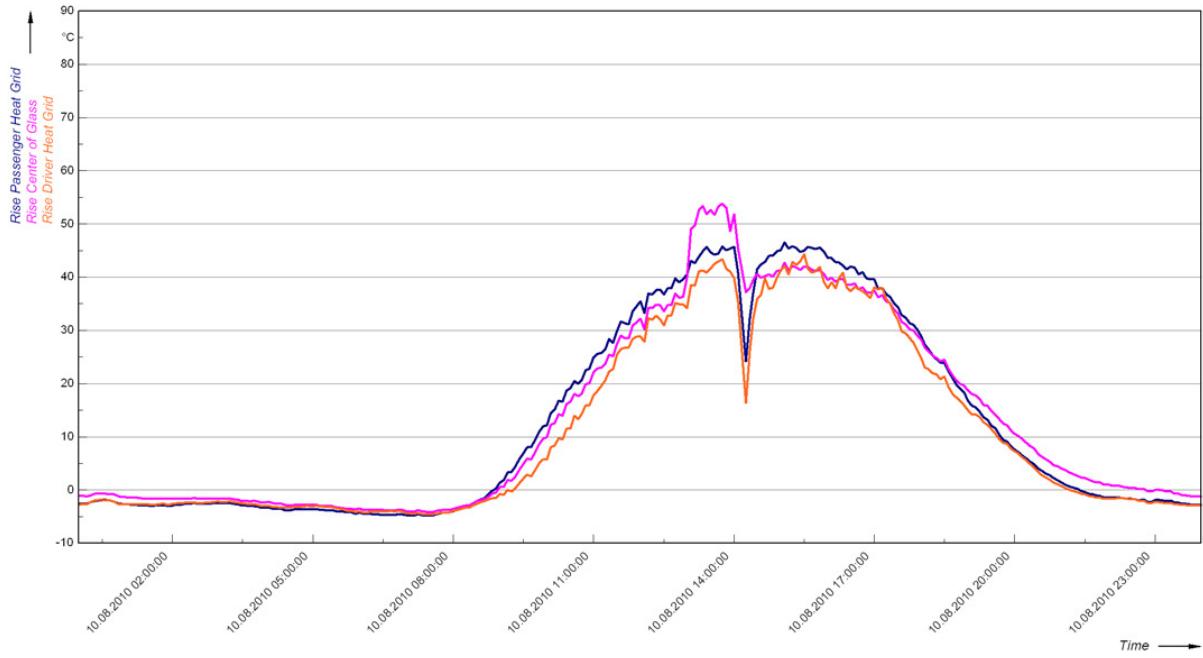
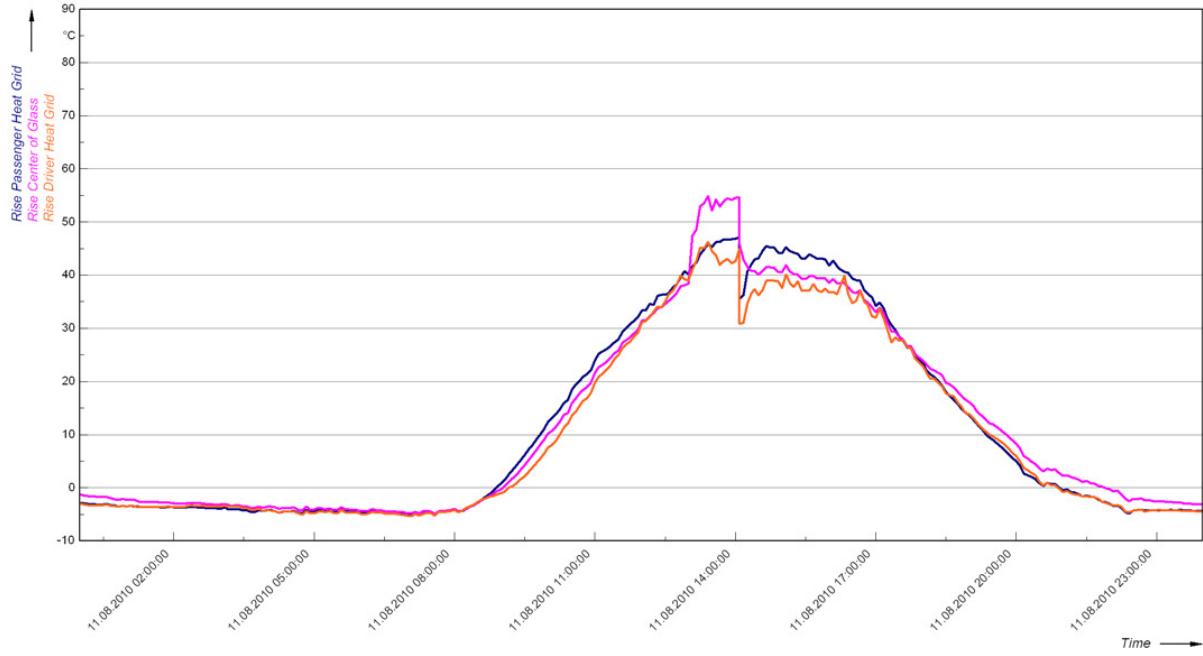


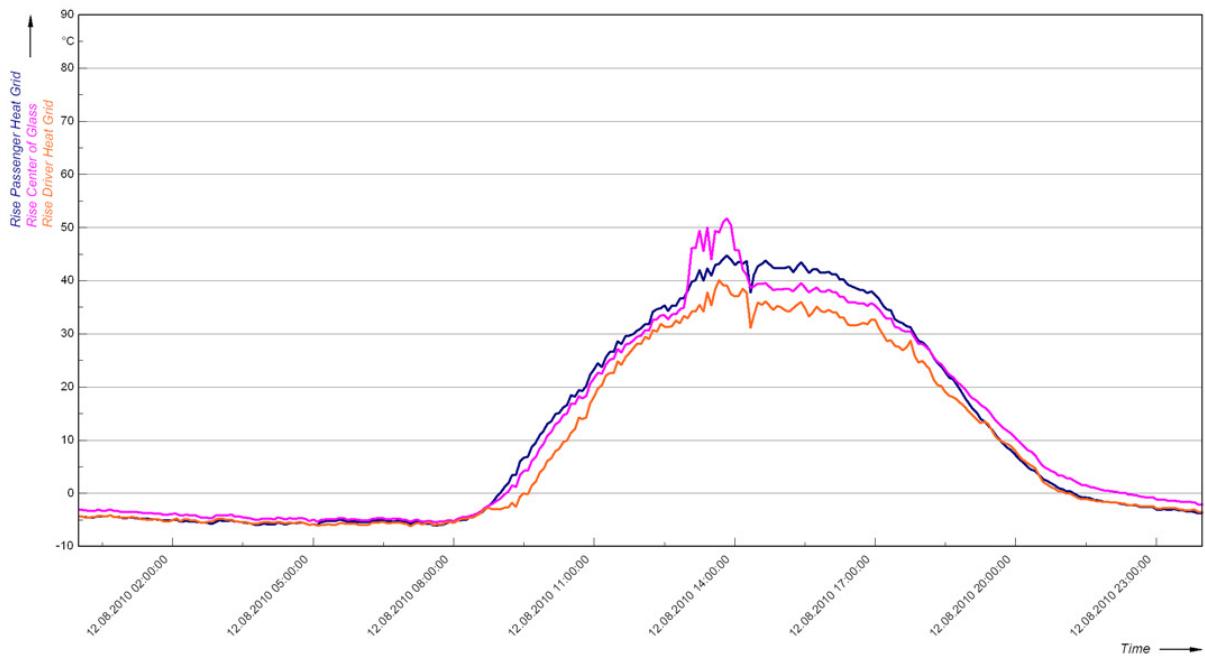
Figure 101: Peugeot 407 - Rise - 09.08.2010



**Figure 102: Peugeot 407 - Rise - 10.08.2010**



**Figure 103: Peugeot 407 - Rise - 11.08.2010**



**Figure 104: Peugeot 407 - Rise - 12.08.2010**

### c. Maximum Temperatures

#### i. VW Eos

| Location                          | Max. Temperature [°C] |
|-----------------------------------|-----------------------|
| Passenger Heat Grid Terminal      | 88,0                  |
| Center of Glass                   | 92,1                  |
| Driver Heat Grid Terminal         | 87,1                  |
| Rise Passenger Heat Grid Terminal | 48,6                  |
| Rise Center of Glass              | 52,1                  |
| Rise Driver Heat Grid Terminal    | 48,4                  |
| Ambient Inside Vehicle            | 51,6                  |
| Ambient Outside Vehicle           | 47,3                  |

**Table 1: Max. Temperatures - VW Eos**

## ii. Skoda Octavia

| Location                          | Max. Temperature [°C] |
|-----------------------------------|-----------------------|
| Passenger Heat Grid Terminal      | 85,5                  |
| Center of Glass                   | 92,3                  |
| Driver Heat Grid Terminal         | 85,0                  |
| Rise Passenger Heat Grid Terminal | 48,6                  |
| Rise Center of Glass              | 55,6                  |
| Rise Driver Heat Grid Terminal    | 47,5                  |
| Ambient Inside Vehicle            | 56,8                  |
| Ambient Outside Vehicle           | 41,1                  |

Table 2: Max. Temperatures - Skoda Octavia

## iii. Audi TT

| Location                          | Max. Temperature [°C] |
|-----------------------------------|-----------------------|
| Passenger Heat Grid Terminal      | 89,0                  |
| Center of Glass                   | 90,3                  |
| Driver Heat Grid Terminal         | 93,3                  |
| Rise Passenger Heat Grid Terminal | 50,4                  |
| Rise Center of Glass              | 53,6                  |
| Rise Driver Heat Grid Terminal    | 53,7                  |
| Ambient Inside Vehicle            | 56,1                  |
| Ambient Outside Vehicle           | 42,5                  |

Table 3: Max. Temperatures - Audi TT

## iv. Peugeot 407

| Location                          | Max. Temperature [°C] |
|-----------------------------------|-----------------------|
| Passenger Heat Grid Terminal      | 89,1                  |
| Center of Glass                   | 96,6                  |
| Driver Heat Grid Terminal         | 88,4                  |
| Rise Passenger Heat Grid Terminal | 47,1                  |
| Rise Center of Glass              | 54,9                  |
| Rise Driver Heat Grid Terminal    | 46,9                  |
| Ambient Inside Vehicle            | 58,8                  |
| Ambient Outside Vehicle           | 43,3                  |

Table 4: Max. Temperatures - Peugeot 407

## 4. Conclusion

|   |                          |
|---|--------------------------|
| Hottest outside temperature recorded on earth:  | Lut Dessert,<br>Iran     |
|   | 70.7°C                   |
|   | satellite<br>measurement |
| Hottest outside temperature recorded in Europe:   | Seville                  |
|   | 48.8°C                   |
| Hottest day of the test:  | 10.08.2010               |
|   | 43,3°C                   |
| Vehicle with the highest temperatures on the heat grid terminals on this day: Peugeot 407 |                          |
| Temperatures before the heat grid was turned on:  |                          |
| Passenger Heat Grid Terminal:   | 77,3°C                   |
| Center of Glass:  | 74,0°C                   |
| Driver Heat Grid Terminal:  | 72,5°C                   |
| Temperatures after the heat grid was turned on:   |                          |
| Passenger Heat Grid Terminal:   | 87,4°C                   |
| Center of Glass:  | 93,6°C                   |
| Driver Heat Grid Terminal:  | 86,1°C                   |

This test report was constructed by EDAG GmbH & Co. KGaA. The measurement data was allocated by Antaya Technologies.

EDAG has done the test report summary by order of Antaya. Additionally Antaya asked EDAG for their opinion, how realistic the Antaya measurements are: (e.g. the possibility that the temperature on glass under realistic conditions will not reach a temperature above 100 °C)

At the hottest day of the tests an ambient temperature of 43.3 °C was measured. The highest temperature inside the vehicle was 58.8 °C, on the glass it was 93.6 °C (with Heat Grid switched on). The hottest day in Europe was measured in Seville with 48.8 °C. The hottest outside temperature on earth is taken with 70.7 °C but not in an inhabited area.

EDAG's opinion (in the case of doubt to be proved by additional measurements):

1. Seville is a suitable place for the temperature measurements.
2. For EDAG Antaya's test setup is understandable (referring to the available test documentation).
3. In automotive standards usually the temperature for interior parts (driver cabin) is assumed with 85 °C. Possibly there are special standards for glasses (to be double-checked).
4. With reference to location Seville the tests done are performed with an ambient temperature of delta=5.5 °C less than the hottest temperature ever measured in that area. It is to be assumed that physically effects (e.g. "cooling" of the glass towards the air outside the vehicle, PTC-behavior of the Heat Grid) are leading to an expected temperature rise of less than that delta. Referring to all this the estimated maximum glass temperature might be of between 95 °C and 100 °C (93.6 °C + 5.5 °C).

Note: "Delta" is defined as the difference in temperature between the hottest day during the test (43.3 °C), and the hottest day ever recorded in Europe (48.8 °C). It has to be taken notice of that the maximum temperature during the test was not recorded in the time when the heat grid was turned on. Additionally the hottest temperature on glass (=96.6 °C) was not measured on the hottest day but on the 11 of August.

5. With a assumed delta of 5.5 degrees the temperature on the heat grid terminals might be summarized as follows:

-Highest Actual Measured Terminal Temperature Before Power:  
77.3 degrees C + 5.5 degrees C (delta) equals 82.8 degrees C.

-Highest Actual Measured Terminal Temperature Under Power:  
87.4 degrees C + 5.5 degrees C (delta) equals 92.9 degrees C