



CERTIFIED SIMULATOR  
No. 039



Calculation for Thermal Transmittance of PVC-U Windows  
In Accordance with  
BS EN ISO 10077-2:2017  
(Effective conductivity method)  
U Value Simulation by Physibel Bisco 12.0w

Client  
Eclectic Systems LLP  
Unit 8  
Quadrant Business Centre  
Davy Way  
Hardwicke  
Gloucester  
GL2 2RN

Date  
7<sup>th</sup> April 2021

Report  
R9\_136

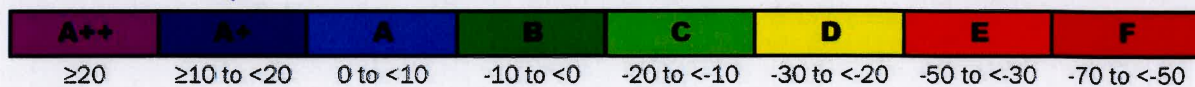
Window Profile  
R9 Flush Casement  
Standard frame, sash and mullion

Insulated Glazing Unit  
44mm unit size  
4·16·4·16·4 configuration  
4mm Diamant · 16mm Argon (90%) · 4mm Total+ · 16mm Argon (90%) · 4mm Total+

Spacer Bar  
Swiss Ultimate

Simulation Result Summary

| Window U Value | Window g Value | L Factor | Energy Rating | Label Index |
|----------------|----------------|----------|---------------|-------------|
| 0.82           | 0.33           | 0.01     | 15.28         | 15          |



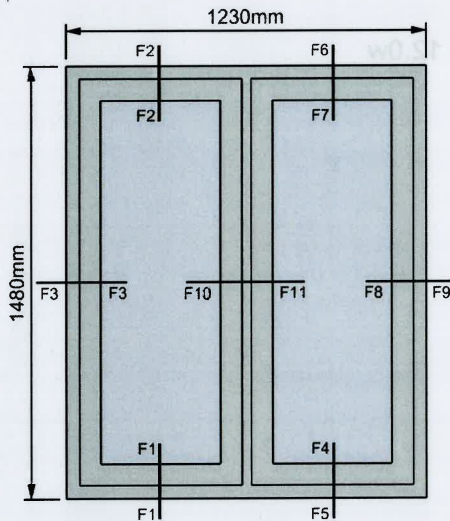


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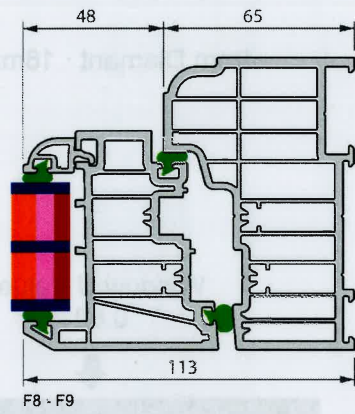
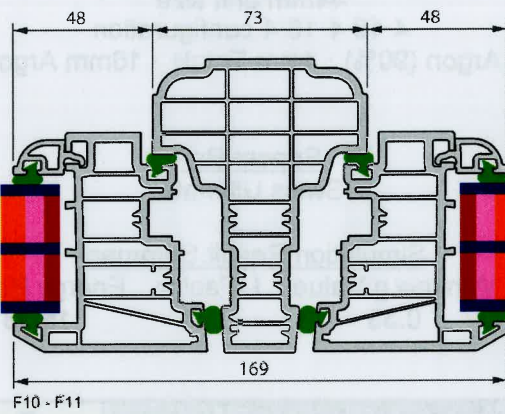
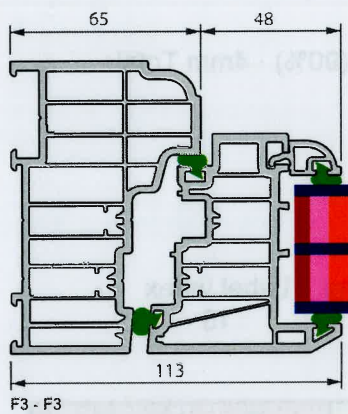
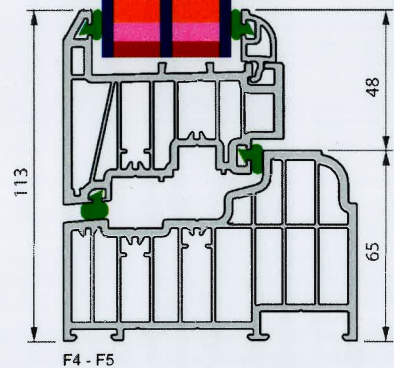
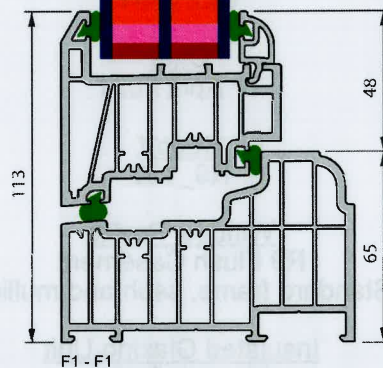
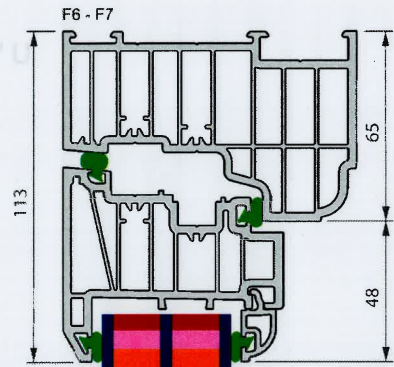
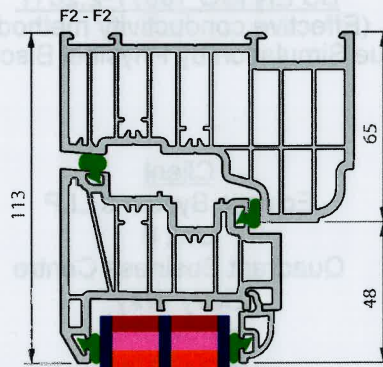


### Window Profile



R9

Standard Frame  
Triple Glazed





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## Glass Unit Specification



Wednesday, April 7, 2021



Climatop 4 DIAMANT (16 Argon 90) 4 (16 Argon 90) 4  
PLANITHERM TOTAL+ FG F3 PLANITHERM TOTAL+ FG F5

|           |                      |
|-----------|----------------------|
| Glazing 1 | DIAMANT 4 mm         |
| Cavity 1  | Argon 90% 16 mm      |
| Coating 3 | PLANITHERM TOTAL+ FG |
| Glazing 2 | PLANICLEAR 4 mm      |
| Cavity 2  | Argon 90% 16 mm      |
| Coating 5 | PLANITHERM TOTAL+ FG |
| Glazing 3 | PLANICLEAR 4 mm      |

Name: Mark Castle  
Country: United Kingdom

Notes:

### LUMINOUS FACTORS

EN410 (2011-04)

|                           |      |
|---------------------------|------|
| Light Transmittance (TL)  | 70 % |
| Outdoor Reflectance (RLe) | 17 % |
| Indoor Reflectance (RLi)  | 15 % |

### THERMAL TRANSMISSION

EN673-2011

|                                |              |
|--------------------------------|--------------|
| Ug                             | 0.6 W/(m².K) |
| Angle relative to the vertical | 0 °          |

### MANUFACTURING SIZES

|                   |            |
|-------------------|------------|
| Nominal Thickness | 44.00 mm   |
| Weight            | 30.0 kg/m² |

### ACOUSTICS

EN 12758

|            |                |
|------------|----------------|
| Rw (C;Ctr) | 32 (-1; -5) dB |
|------------|----------------|

### UV FACTORS

EN410 (2011-04)

|     |      |
|-----|------|
| TUV | 29 % |
|-----|------|

### SAFETY CLASS

EN 12600

|                          |     |
|--------------------------|-----|
| Pendulum Body Resistance | NPD |
|--------------------------|-----|

### ENERGY FACTORS

EN410 (2011-04)

|                           |      |
|---------------------------|------|
| Transmittance (TE)        | 53 % |
| Outdoor Reflectance (Ree) | 27 % |
| Indoor Reflectance (Rei)  | 26 % |
| Absorptance A1 (AE1)      | 3 %  |
| Absorptance A2 (AE2)      | 11 % |
| Absorptance A3 (AE3)      | 7 %  |

### SOLAR FACTORS

EN410 (2011-04)

|                          |      |
|--------------------------|------|
| Solar Factor (g)         | 0.64 |
| Shading Coefficient (SC) | 0.74 |

### COLOR RENDERING

|                   |    |
|-------------------|----|
| Transmission (Ra) | 98 |
| Reflection (Ra)   | 87 |

### ANTI-BURGLARY

EN 356

|                    |     |
|--------------------|-----|
| Burglar Resistance | NPD |
|--------------------|-----|

Calumen calculates the photometric characteristics and thermal transmission of glass using calculation algorithms which comply with the following standards: the European standards EN 410 and EN 673, the international standard ISO9050, the Japanese standard JIS R 3106/3107 and the Korean standard KS L 2514/2525. The functional output and calculation rules of Calumen for standards EN 410 and EN 673 have been validated by TUV Rheinland (report 11923R-11-33705). The technical performances obtained according to these standards are provided for information only and are subject to amendment. Only the values entered in the performance declaration available on the CE marking site of Saint-Gobain Glass are official. The sound attenuation indices are measured under laboratory conditions according to the standards EN ISO 10140 and EN 12758. The calculated indices are provided for information only. The accuracy for Rw index lies within a range of +/-2dB. The glass thickness calculations comply with the 2012 version of the DTU39-P4 description. The USER is responsible for ensuring that the correct calculation hypotheses are entered and the DTU39 is applied appropriately for the project concerned.



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### Glass Unit Specification (cont...)

Version 12 18/06/2015. Calculations according to BS EN 673:2011

|                  |
|------------------|
| Number of spaces |
| 2                |

|                              |  |           |       |                           |     |                           |     |                           |
|------------------------------|--|-----------|-------|---------------------------|-----|---------------------------|-----|---------------------------|
|                              |  | Spaces    |       | 1                         |     | 2                         |     |                           |
| Glazing orientation          |  | Vertical  |       | P<br>a<br>n<br>e<br><br>1 | 90% | P<br>a<br>n<br>e<br><br>2 | 90% | P<br>a<br>n<br>e<br><br>3 |
| Resistivity panes            |  | 1         | m·K/W |                           |     |                           |     |                           |
| Outside                      |  |           |       |                           |     |                           |     |                           |
| Thickness (mm)               |  | 4.0       | 16    | 4.0                       | 16  | 4                         |     |                           |
| Normal emissivity            |  | 0.89 0.05 |       | 0.89 0.05                 |     |                           |     |                           |
| $\sum d_i \cdot r_i = 0.012$ |  | Uncoated  |       | Uncoated                  |     |                           |     |                           |

For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.837

|                    |                   |                   |
|--------------------|-------------------|-------------------|
| External, $R_{se}$ | 0.04              | $(m^2 \cdot K)/W$ |
| Internal, $R_{si}$ | 0.13              | $(m^2 \cdot K)/W$ |
| Iteration number   | U value           | $\sum 1/h_s$      |
|                    | $W/(m^2 \cdot K)$ | $(m^2 \cdot K)/W$ |
| 1                  | 0.622             | 1.42542           |
| 2                  | 0.622             | 1.42542           |

|                 |            |
|-----------------|------------|
| $\lambda_{eff}$ | $\Delta T$ |
| $W/(mK)$        |            |
| 0.0224          | 7.5        |
| 0.0224          | 7.5        |

|                 |            |
|-----------------|------------|
| $\lambda_{eff}$ | $\Delta T$ |
| $W/(mK)$        |            |
| 0.0224          | 7.5        |
| 0.0224          | 7.5        |



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## Spacer Bar Datasheet

April 2013 – No.19 – Revision index 0

'WARM EDGE' WORKING PARTY



### Data sheet Psi values for windows

based on determination of the equivalent thermal conductivity of spacers by measurement

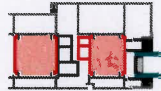
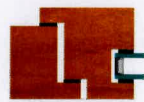
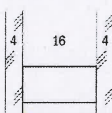
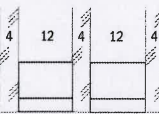
**SWISSPACER®**

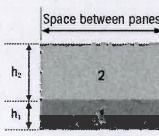
Vetrotech Saint-Gobain (International) AG  
Zweigniederlassung Kreuzlingen  
Sonnenwiesenstrasse 15  
CH-8280 Kreuzlingen

**SWISSPACER®**



|               | Product name                                                                                                    | Spacer height in mm | Material                                                                     | Thickness d in mm |
|---------------|-----------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------|-------------------|
| Cross-section |  <b>Ultimate</b><br>SWISSPACER | 6.5                 | Plastic / Multilayer – polyester coated film<br>"High Tech Gas Barrier Foil" | 1.0<br>0.097      |

|                                                                       |                                                                                                                                                           | Metal with thermal break                                                            | Plastic                                                                             | Wood                                                                                 | Wood / Metal                                                                          |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Representative frame profile                                          |                                                                                                                                                           |  |  |  |  |
| Representative psi value double sheet thermally insulating glass W/mK | <br>Double-sheet insulating glass<br>$U_g = 1.1 \text{ W/m}^2\text{K}$ | 0.036                                                                               | 0.032                                                                               | 0.031                                                                                | 0.032                                                                                 |
| Representative psi value triple-sheet thermally insulating glass W/mK | <br>Triple-sheet insulating glass<br>$U_g = 0.7 \text{ W/m}^2\text{K}$ | 0.031                                                                               | 0.030                                                                               | 0.029                                                                                | 0.030                                                                                 |

| Two Box model<br>Characteristic values |  | Space between panes in mm         | $\lambda_{eq,2B}$ in W/mK    |                                |
|----------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------|------------------------------|--------------------------------|
|                                        |                                                                                     |                                   | Box 1 · $h_1 = 3 \text{ mm}$ | Box 2 · $h_2 = 6.5 \text{ mm}$ |
|                                        |                                                                                     | Can be used for all spacer widths | 0.40                         | 0.14                           |

Explanations

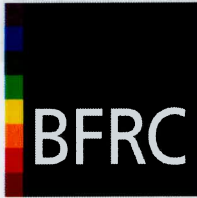
The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17/1 "Thermally improved spacers – Determination of the equivalent thermal conductivity by measurement". The representative linear heat transfer coefficients calculated in this way (representative psi values) apply to typical frame profiles and glazing for the determination of the heat transfer coefficient U<sub>W</sub> of windows. They have been determined under the boundary conditions (frame profiles, glazing, glass mounting depth, back covering, primary and secondary sealant) defined in the ift guideline WA-08/2 "Thermally improved spacers – Part 1: Determination of the representative Psi value for window frame profiles". This guideline also governs the area of validity and application of the representative psi values. In order to avoid rounding errors, the psi values in the data sheet have been given at 0.001 W/mK. The method for the arithmetical determination of the psi values has an accuracy of ± 0.003 W/mK. Differences of less than 0.005 W/mK are not significant. For further information, refer to the Bulletin 004/2008 "Compass 'Warm Edge' for Windows" of Bundesverband Flachglas.

Ermittlung der Kennwerte durch:

Hochschule Rosenheim  
University of Applied Sciences



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**Air Permeability Test Results**  
**BS 6375-1:2009 / BS EN 1026:2000**  
**Exova Warringtonfire Test Report No. WIL335987**  
**Report Date 19<sup>th</sup> May 2014**

| Test Pressure<br>(Pa) | Air permeability per unit length  |                                   |                                  | Simulation it<br>relates to |
|-----------------------|-----------------------------------|-----------------------------------|----------------------------------|-----------------------------|
|                       | Positive<br>(m <sup>3</sup> /h.m) | Negative<br>(m <sup>3</sup> /h.m) | Average<br>(m <sup>3</sup> /h.m) |                             |
| 50                    | 0.33                              | 0.31                              | 0.32                             | R9_136                      |
| 100                   | 0.52                              | 0.51                              | 0.52                             |                             |
| 150                   | 0.68                              | 0.68                              | 0.68                             |                             |
| 200                   | 0.82                              | 0.81                              | 0.82                             |                             |
| 250                   | 0.96                              | 0.94                              | 0.95                             |                             |
| 300                   | 1.08                              | 1.07                              | 1.07                             |                             |
| 450                   | 1.42                              | 2.03                              | 1.72                             |                             |
| 600                   | 1.74                              | 5.35                              | 3.55                             |                             |







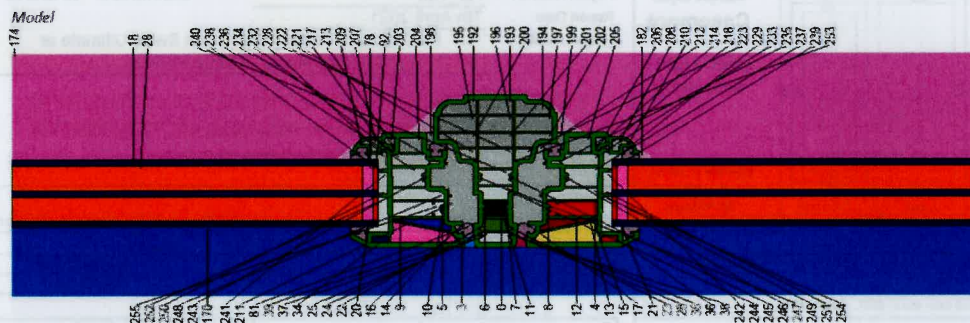
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THE RESIDENCE COLLECTION

## F10-F11 L<sub>ψ</sub>2D



### Boundary conditions

| Colour ID | Name               | Temperature<br>[°C] | Surface resistance<br>[m².K/W] |
|-----------|--------------------|---------------------|--------------------------------|
| 170       | exterior           | 0                   | 0.04                           |
| 174       | interior (normal)  | 20                  | 0.13                           |
| 182       | interior (reduced) | 20                  | 0.2                            |

### Materials

| Colour ID | Name                                                                                  | Thermal conductivity<br>[W/(m.K)] | Emissivity<br>[-] | EN ISO 10077-2:2017<br>Annex D |
|-----------|---------------------------------------------------------------------------------------|-----------------------------------|-------------------|--------------------------------|
| 3         | PVC rigid                                                                             | 0.17                              |                   | x                              |
| 18        | soda lime                                                                             | 1                                 |                   | x                              |
| 28        | 4/16/4/16/4 argon 0.05 low e                                                          | 0.0224                            |                   |                                |
| 37        | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 38        | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 78        | Swiss Ultimate or Thermobar                                                           | 0.14                              |                   |                                |
| 81        | q-lon                                                                                 | 0.06                              |                   |                                |
| 92        | PU / PS                                                                               | 0.4                               |                   |                                |
| 198       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 199       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 253       | cavity <1x1 mm²                                                                       | 0.028                             |                   |                                |
|           | unventilated cavities - single equivalent thermal conductivity method (ε1=0.9 ε2=0.9) |                                   |                   |                                |

Linear thermal transmittance of the junction with the glazing,  $\psi_g$

0.026 W/(m.K)  
(0.026)

Total heat flow rate,  $\Phi$

9.0563 W/m

Temperature difference between environments

20 °C

Thermal conductance,  $L^{2D}$

0.4528 W/(m.K)

Thermal transmittance of the frame section,  $U_f$

0.901 W/(m².K)

Projected width of the frame section,  $b_f$

0.1690 m

Thermal transmittance of the glazing,  $U_g$

0.622 W/(m².K)

Visible width of the glazing,  $b_g$

0.4000 m

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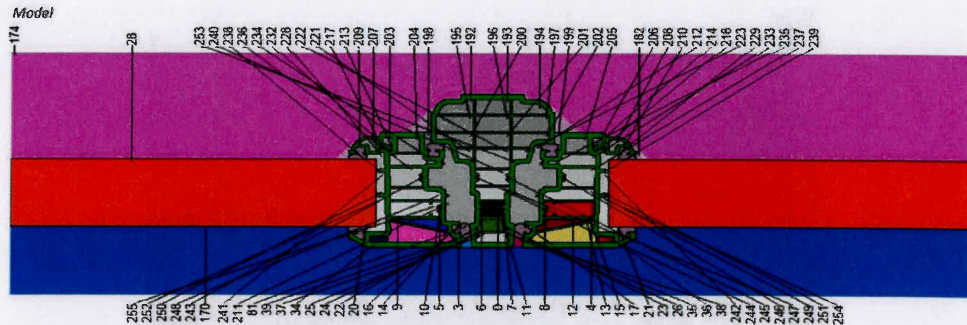


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## F10-F11 L2D



### Boundary conditions

| Colour ID | Name               | Temperature<br>[°C] | Surface resistance<br>[m².K/W] |
|-----------|--------------------|---------------------|--------------------------------|
| 170       | exterior           | 0                   | 0.04                           |
| 174       | interior (normal)  | 20                  | 0.13                           |
| 182       | interior (reduced) | 20                  | 0.2                            |

### Materials

| Colour ID | Name                                                                                  | Thermal conductivity<br>[W/(m.K)] | Emissivity<br>[-] | EN ISO 10077-2:2017<br>Annex D |
|-----------|---------------------------------------------------------------------------------------|-----------------------------------|-------------------|--------------------------------|
| 3         | PVC rigid                                                                             | 0.17                              |                   | x                              |
| 28        | insulation panel                                                                      | 0.035                             |                   |                                |
| 32        | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 33        | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 81        | q-lon                                                                                 | 0.06                              |                   |                                |
| 198       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 199       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                                   |                   |                                |
| 253       | cavity <1x1 mm2                                                                       | 0.028                             |                   |                                |
|           | unventilated cavities - single equivalent thermal conductivity method (ε1=0.9 ε2=0.9) |                                   |                   |                                |

Thermal transmittance of the frame section,  $U_f$

0.90 W/(m².K)  
(0.901)

Total heat flow rate,  $\Phi$

8.6645 W/m

Temperature difference between environments

20 °C

Thermal conductance,  $L^{2D}$

0.4332 W/(m.K)

Thermal transmittance of the panel,  $U_p$

0.701 W/(m².K)

Visible width of the panel,  $b_p$

0.2000 m

Thickness of the panel,  $d$

0.0440 m

Thermal transmittance of the second panel,  $U_p$

0.701 W/(m².K)

Visible width of the second panel,  $b_p$

0.2000 m

Thickness of the second panel,  $d$

0.0440 m

Projected width of the frame section,  $b_f$

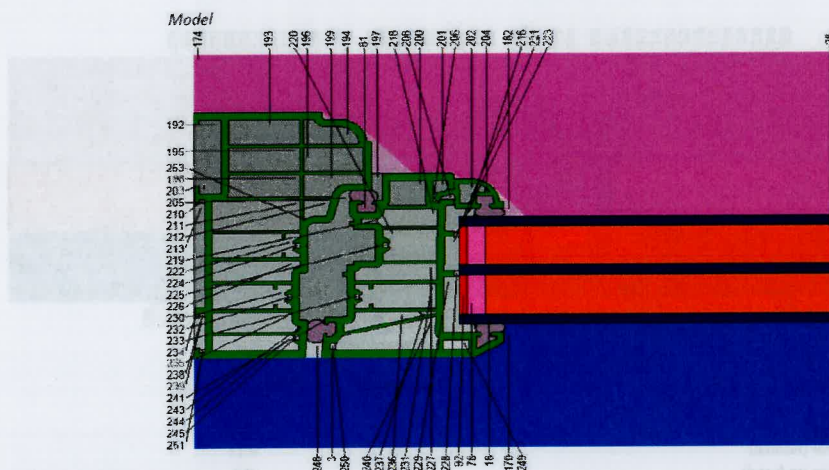
0.1690 m

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F1-F1, F2-F2, F3-F3, F4-F5, F6-F7, F8-F9 L<sub>ψ</sub>2D



Boundary conditions

| Colour ID | Name               |
|-----------|--------------------|
| 170       | exterior           |
| 174       | interior (normal)  |
| 182       | interior (reduced) |

| Temperature | Surface resistance |
|-------------|--------------------|
| [°C]        | [m².K/W]           |
| 0           | 0.04               |
| 20          | 0.13               |
| 20          | 0.2                |

Materials

| Colour ID | Name                                                                                  | Thermal conductivity | Emissivity | EN ISO 10077-2:2017 |
|-----------|---------------------------------------------------------------------------------------|----------------------|------------|---------------------|
|           |                                                                                       | [W/(m.K)]            | [-]        | Annex D             |
| 3         | PVC rigid                                                                             | 0.17                 |            | x                   |
| 18        | soda lime                                                                             | 1                    |            | x                   |
| 28        | 4/16/4/16/4 argon 0.05 low e                                                          | 0.0224               |            |                     |
| 78        | Swiss Ultimate or Thermobar                                                           | 0.14                 |            |                     |
| 81        | q-Ion                                                                                 | 0.06                 |            |                     |
| 92        | PU / PS                                                                               | 0.4                  |            |                     |
| 197       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                      |            |                     |
| 248       | slightly ventilated cavity (ε1=0.9 ε1=0.9)                                            |                      |            |                     |
| 253       | cavity <1x1 mm2                                                                       | 0.028                |            |                     |
|           | unventilated cavities - single equivalent thermal conductivity method (ε1=0.9 ε2=0.9) |                      |            |                     |

Linear thermal transmittance of the junction with the glazing,  $\psi_g$  0.026 W/(m.K)  
(0.026)

Total heat flow rate,  $\Phi$  4.9501 W/m  
Temperature difference between environments 20 °C  
Thermal conductance,  $L^{2D}$  0.2475 W/(m.K)  
Thermal transmittance of the frame section,  $U_f$  0.863 W/(m².K)  
Projected width of the frame section,  $b_f$  0.1130 m  
Thermal transmittance of the glazing,  $U_g$  0.622 W/(m².K)  
Visible width of the glazing,  $b_g$  0.2000 m



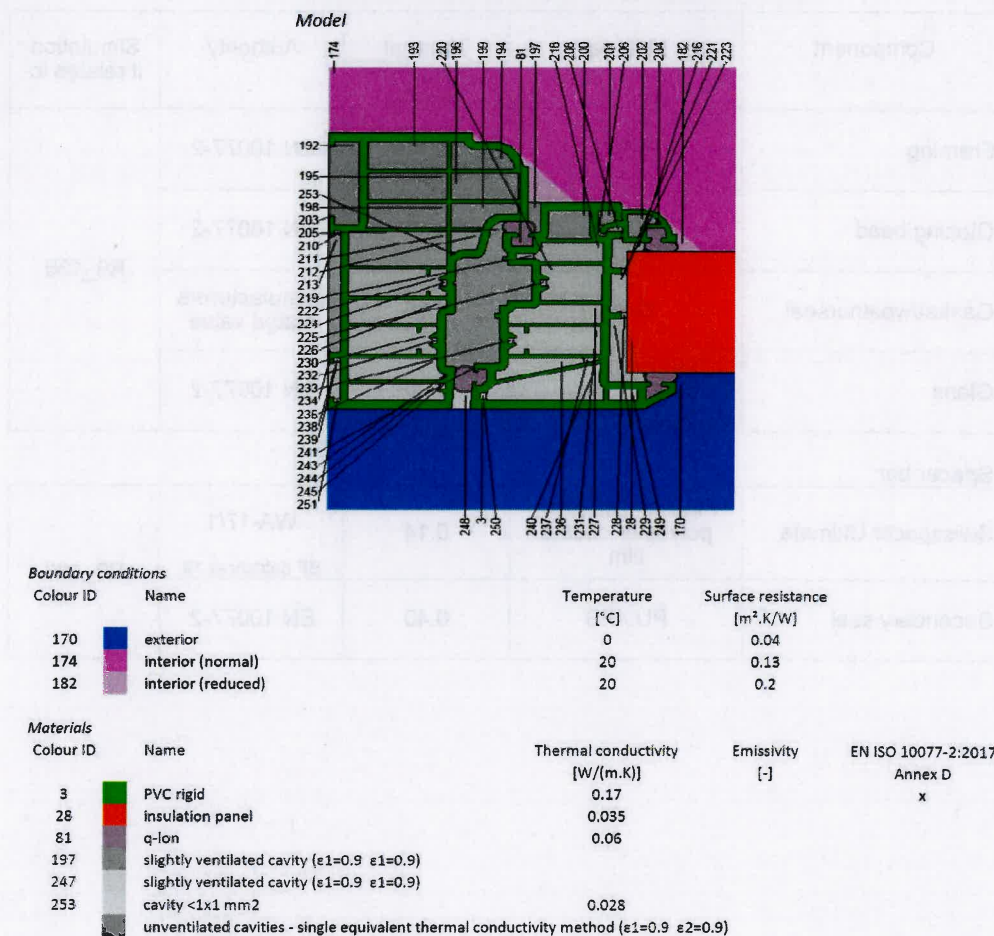


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## F1-F1, F2-F2, F3-F3, F4-F5, F6-F7, F8-F9 L2D



Thermal transmittance of the frame section,  $U_f$

0.86 W/(m².K)  
(0.863)

Total heat flow rate,  $\Phi$

4.7539 W/m

Temperature difference between environments

20 °C

Thermal conductance,  $L^{2D}$

0.2377 W/(m.K)

Thermal transmittance of the panel,  $U_p$

0.701 W/(m².K)

Visible width of the panel,  $b_p$

0.2000 m

Thickness of the panel,  $d$

0.0440 m

Projected width of the frame section,  $b_f$

0.1130 m

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### Component Material Specifications

| Component          | Material     | Thermal Conductivity (W/mK) | Authority                  | Simulation it relates to |
|--------------------|--------------|-----------------------------|----------------------------|--------------------------|
| Framing            | PVCU         | 0.17                        | EN 10077-2                 | R9_136                   |
| Glazing bead       | PVCU         | 0.17                        | EN 10077-2                 |                          |
| Gasket/weatherseal | Q-Ion        | 0.06                        | Manufacturers stated value |                          |
| Glass              | Saint Gobain | 1.00                        | EN 10077-2                 |                          |

#### Spacer bar

|                     |                                           |      |                            |        |
|---------------------|-------------------------------------------|------|----------------------------|--------|
| Swisspacer Ultimate | Plastic/multi-layer polyester coated film | 0.14 | WA-17/1<br>BF datasheet 19 | R9_136 |
| Secondary seal      | PU / PS                                   | 0.40 | EN 10077-2                 |        |