This test summary, downloaded from the BESA website, indicates that the HIU listed below has been tested against the criteria of the BESA HIU Test Regime.

BESA BUILDING ENGINEERING SERVICES ASSOCIATION

Model: Danfoss VVX-IV 1-5 RAD

Serial Number: K2953653-1

Year of manufacture: 2022

Test carried out by BSRIA Ltd On: 7/12/22 Reference: 104363/1

| *NOTE: The VWART accuracy is in the range +/-2°C* | HIGH TEMP VWART ⁰C | LOW TEMP VWART ⁰C |
|---|---|---|
| DHW | 16 | 17 |
| Keep-warm | 43 | 41 |
| Space heating | 40 | 35 |
| Overall with keep warm | 32 | 32 |

| **Pressure test** | | |
|---|---|---|
| No HIU damage | Pass | Pass |

| **Dynamic DHW operation** | 2a | |
|---|---|---|
| DHW not exceed 65°C | Pass | Pass |

| **Low flow test at BESA flow rate of 0.02l/s** | 3a | 3b |
|---|---|---|
| DHW not exceed 65°C | Pass | Pass |
| DHW temperature at set point +/- 3°C | Pass | Pass |

| **Low flow test at manufacturer declared flow rate** | 3c | 3d |
|---|---|---|
| Declared minimum flow rate (l/sec) | | |
| Not exceed 65°C | n/a | n/a |
| DHW temperature at set point +/- 3°C | n/a | n/a |

| **Keep-warm test** | 4a | 4b |
|---|---|---|
| Standby heat consumption - average (Watts) | 28 | 34 |
| Standby electricity consumption - average (Watts) | 0 | 0 |
| Total HIU heat loss (DH + electrical input) (Watts) | 28 | 34 |
| Standby flow rate (the average flow rate) (l/hr) | 3.7 | 5.2 |

| **DHW Response time test** | 5a | 5b |
|---|---|---|
| DHW response time (Seconds) | 4 | 7 |
| Peak electrical heat during test (Watts) | 0 | 0 |
| Output | | |
| DHW temperature not exceed 65°C for more than 10 secs | Pass | Pass |
| DHW reaches 45°C with 15 secs | Pass | Pass |

| **Scaling risk assessment as defined in 2.26** | If any of the factors below occur then the risk of scaling of the DHW PHE in hard water areas increases | | |
|---|---|---|---|
| HIU has a TMV or TRV on the DHW | No | | |
| Test | 2a | 3a | 3c |
| t32 above 60°C for more than 5 secs | No | No | n/a |
| t12 exceeds 55°C at any point of the test | No | No | n/a |
| Test | 4a | | 4b |
| t12 exceeds 50°C at any time | No | | n/a |

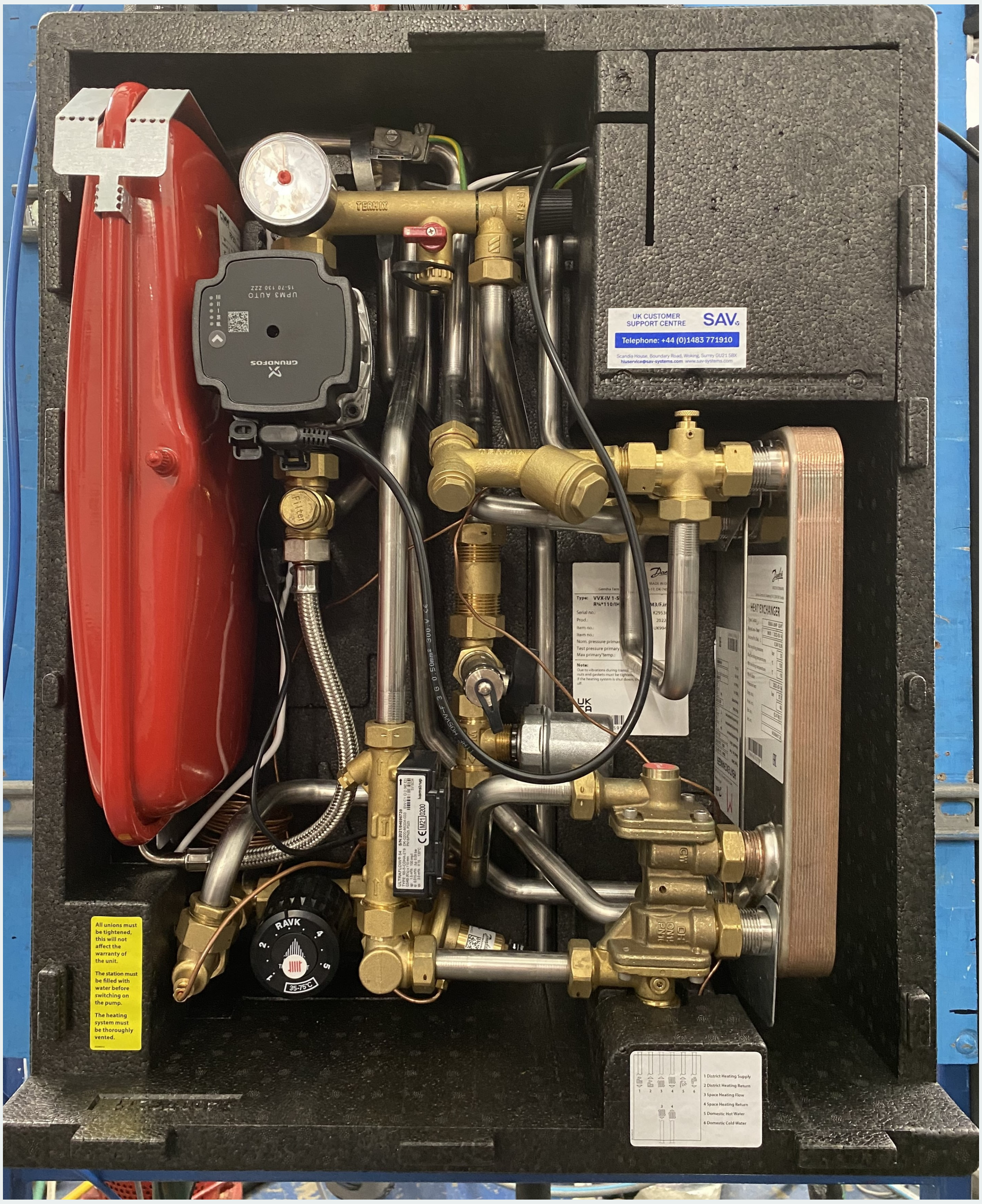


Photo of HIU being tested with the cover off.

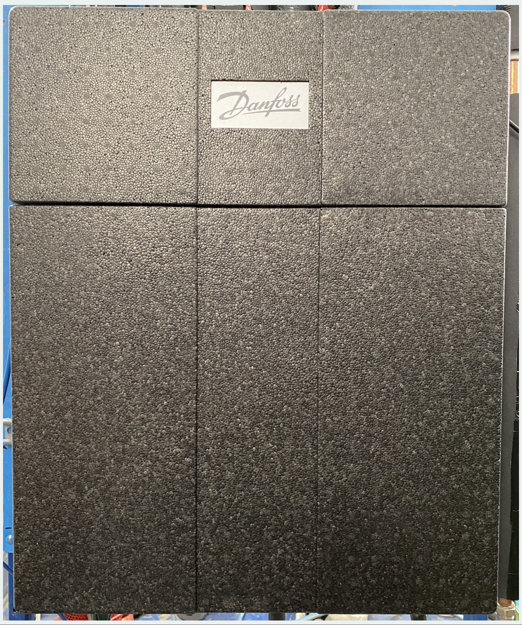


Photo of HIU being tested with the cover on.

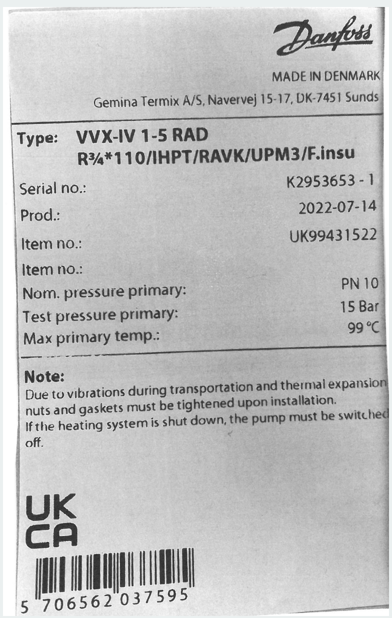


Photo of Manufacturers label and serial number.

## COMPONENT DATA AND DOCUMENTATION

| Component and Part No. | Manufacturer and Type | Documents submitted |
|---|---|---|
| a) Space heating heat exchanger | Danfoss XB06 U | Yes |
| b) Domestic hot water heat exchanger | Danfoss XB06 U | Yes |
| c) Control valve and actuator for space heating | Valve:Danfoss VMA Actuator:Danfoss RAVK & TWA-V | Yes |
| d) Space heating strainer | Termix Strainer | Yes |
| e) Control valve and actuator for domestic hot water | Danfoss IHPT | Yes |
| f) Domestic hot water isolating valve/check valve | Socla (Watts) | Yes |
| g) Primary side strainer | Termix Strainer | Yes |
| k) Circulation pump | Grundfos UPM3 | Yes |
| m) Joints and connections | n/a | Yes |
| n) Gaskets | Reinz AFM 34 | Yes |
| o) Pipes | Schoeller Werk, Ø18 AISI 304 Pipes | Yes |
| p) Differential pressure control valve | Danfoss AVPL | Yes |
| q) Expansion vessel | CIM | Yes |
| r) Safety valves | Watts | Yes |
| s) Shock absorber (incoming cold water) | FAR | Yes |
| t) Manometer and thermometer | IMIT | Yes |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |
| | | n/a |

| | | |
|---|---|---|
| Schematic diagram and drawing showing the structure and arrangement of the HIU with dimensions and weight | LGB55001.pdf<br>uk99430312_Complete-HIU_drw.pdf<br>UK99431522_HIU-Diagram.pdf | Yes |
| Technical specification for electronic components including version of software | | n/a |
| Installation guide | LGB55001.pdf | Yes |
| Commissioning guide | LGB55001.pdf | Yes |
| Operation guide with a function description/ description of operations and care instructions as suited to the intended user category | LGB55001.pdf | Yes |
| Declaration of Conformity for CE-marked HIUs | LGB55001.pdf | Yes |
| Full parameter list for electronically controlled HIUs | | n/a |

| HIU Marking | Comment | Info present |
|---|---|---|
| Model name and type no. | Danfoss VVX-IV 1-5 RAD | Yes |
| Serial no. | K2953653-1 | Yes |

## HIU MANUFACTURERS' DECLARED INFORMATION (TO BE COMPLETED BY THE MANUFACTURER)

| | |
|---|---|
| HIU Model | Danfoss VVX-IV 1-5 RAD |
| Part No. | UK99431522 |
| Software version | n/a |
| Test Date: | 12/07/2022 |
| Test No. | 104363 |

| DIMENSIONAL INFORMATION | |
|---|---|
| Dimensions with casing (HxDxW) (mm) | H710 x D270 x W530 |
| Primary connections top/bottom | Top (p. 5 in LGB5501) |
| Secondary HTG connections top/bottom | Top (Bottom optional) |
| Secondary BCW/DHW connections top/bottom | Top |
| Connection sizes Prim/Sec DHW/Sec HTG (mm) | G ¾" (Internal thread) |
| Empty weight kg** (Kg) | 26 |
| Operating weight kg** (Kg) | 34 |

| ELECTRICAL INFORMATION | |
|---|---|
| Power supply (230V 1 phase) | **230V 1~** |
| Maximum power (Watts) | 54 |
| Standby power demand (Watts) | 2 |

| HYDRAULIC INFORMATION | |
|---|---|
| Maximum primary pressure (Bar g) | 15 |
| Maximum primary temperature (°C) | 99 |
| Primary water volume (l) | |
| Maximum secondary DHW pressure (Bar g) | 9 |
| Maximum secondary DHW temperature (°C) | 60 |
| Secondary DHW water volume (l) | |
| Maximum secondary HTG pressure (Bar g) | 6 |
| Maximum secondary HTG temperature (°C) | 85 |
| Primary operating DP range min/max (kPa) | |

| DECLARED MAXIMUM PERFORMANCE LT TEST CONDITIONS | |
|---|---|
| DHW | |
| Maximum DHW production at 70°C (kW) | |
| Primary flow temperature (°C) | **70** |
| Primary return temperature (°C) | |
| Primary flow (m3/h) | |
| Primary △P* (kPa) | |
| Secondary in/out temperature (°C) | **10/55** |
| Secondary △P (bar) | |
| HTG | |
| Maximum HTG production (kW) | |
| Primary flow temprature (°C) | **70** |
| Primary return temperature (°C) | |
| Primary △P* (bar) | |
| Secondary in/out temperature (°C) | **40/60** |
| Secondary available DP at the output of HIU | |

| DECLARED MAXIMUM PERFORMANCE LT TEST CONDITIONS | |
|---|---|
| DHW | |
| Maximum DHW production at 60ºC (kW) | |
| Primary flow temperature (ºC) | **60** |
| Primary return temperature (ºC) | |
| Primary flow (m³/h) | |
| Primary △P* (kPa) | |
| Secondary in/out temprature (ºC) | **10/50** |
| Secondary △P (bar) | |
| HTG | |
| Maximum HTG production (kW) | |
| Primary flow temprature (ºC) | **60** |
| Primary return temperature (ºC) | |
| Primary △P* (bar) | |
| Secondary in/out temperature (ºC) | **35/45** |
| Secondary avialable DP at the output of the HIU (kPa) | |
| | |
| HIU P&ID supplied by manufacturer with a legend for the components | Yes |

*DP pressure not to include HM. Designers must add HM pressure drop.
** Including HIU, casing and wall hung bracket

The information included in this page is for the specific model of HIU detailed in this test report. It is additional information voluntarily provided by the manufacturer who is solely accountable for the details sumbmitted.

## MANUFACTURERS' DECLARATION

This is to confirm that the information supplied by relates to the specific HIU tested and is an accurate representation of the product listed on the BESA HIU Register.

Signed Karina Friis Skov Position Engineering Director Company Gemina Termix A/S

## COMMENTS/HISTORY

# BESA HIU Test Report

## Danfoss VVX-IV 1-5 RAD

Carried out for

SAV Systems

Report 104363/1 (Final)

Compiled by Colin Judd

30 August 2022




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# BESA HIU Test Report

## Danfoss VVX-IV 1-5 RAD

| | |
|---|---|
| Carried out for: | SAV Systems<br>Scandia House<br>Boundary Road<br>Woking, Surrey<br>GU21 5BX<br>UK |
| Contract: | Report 104363/1 (Final) |
| Issued by: | BSRIA Limited<br>Old Bracknell Lane West<br>Bracknell<br>Berkshire<br>RG12 7AH<br>UK |
| Telephone: | +44 (0)1344 465600 |
| Fax: | +44 (0)1344 465626 |

Email: bsria@bsria.co.uk
Website: www.bsria.com/uk/

## QUALITY ASSURANCE

| Issue | Date | Compiled by: | Approved by: | Signature |
|---|---|---|---|---|
| *Final* | *30-Aug-2022* | *Colin Judd* | *Mark Roper* | |
| | | *Senior Test Engineer* | *Head of Laboratory* | |

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# FIGURES

# TABLES



# APPENDICES

# 1 INTRODUCTION

BSRIA carried out a series of tests on one heat interface unit (HIU), the Danfoss VVX-IV 1-5 RAD, manufactured by Gemina Termix and supplied by SAV Systems. Testing was carried out in accordance with the UK HIU Test Regime, October 2018. The test method covers testing one HIU at a primary inlet temperature of 70°C and 60°C. The HIU was a combined low temperature hot water (LTHW) and domestic hot water (DHW) unit.

This report is based on one sample of the above-mentioned product. Testing was carried out during July 2022. Charts of outputs obtained from this series of tests are shown in Appendix A of this report.

# 2 ITEM RECEIVED FOR TEST

**Table 1 Product details**

| Description | Name |
|---|---|
| Type | Mechanical |
| Original Manufacturer | Gemina-Termix A/S |
| Brand Name | Danfoss |
| Model Name | VVX-IV |
| Model Qualifier | 1 – 5 Rad |

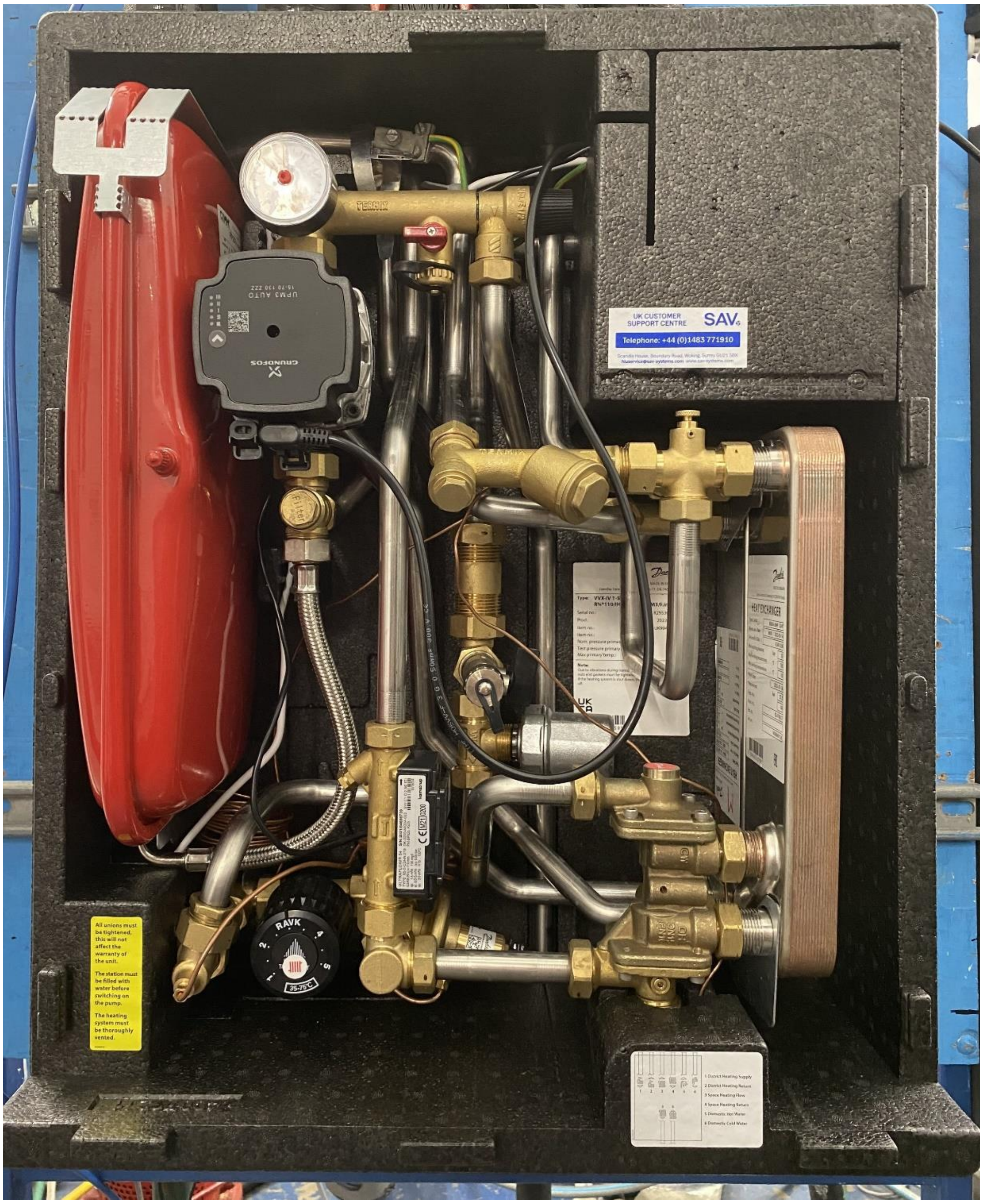
The HIU received for testing was a Danfoss VVX-IV 1-5 RAD. This was a combined LTHW and DHW unit and was completely mechanical. The HIU was designed for both wet radiator systems and underfloor heating (UFH) systems. The test regime requires the HIU is tested at two primary inlet temperatures, 70°C for wet radiator systems and 60°C for UFH systems. Table 2 gives details of the HIU tested.

**Table 2 Manufacturer supplied data**

| Description | Data |
|---|---|
| Model | Danfoss VVX-IV 1-5 RAD |
| Serial Number | K2953653-1 |
| Year of manufacture | 2022 |
| Maximum working pressure primary side | 15 Bar |
| Maximum working pressure DHW side | 9 Bar |
| Maximum working pressure space heating side | 6 Bar |
| Maximum temperature primary side | 99°C |
| Maximum temperature DHW side | 60°C |
| Maximum temperature space heating side | 85°C |

Figure 1 shows the Danfoss VVX-IV 1-5 RAD installed in the test rig with the cover removed. A picture of the name plate is also included.

**Figure 1 Danfoss VVX-IV 1-5 RAD, installed in the test rig**



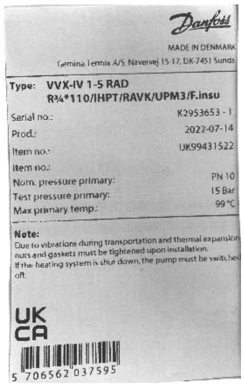
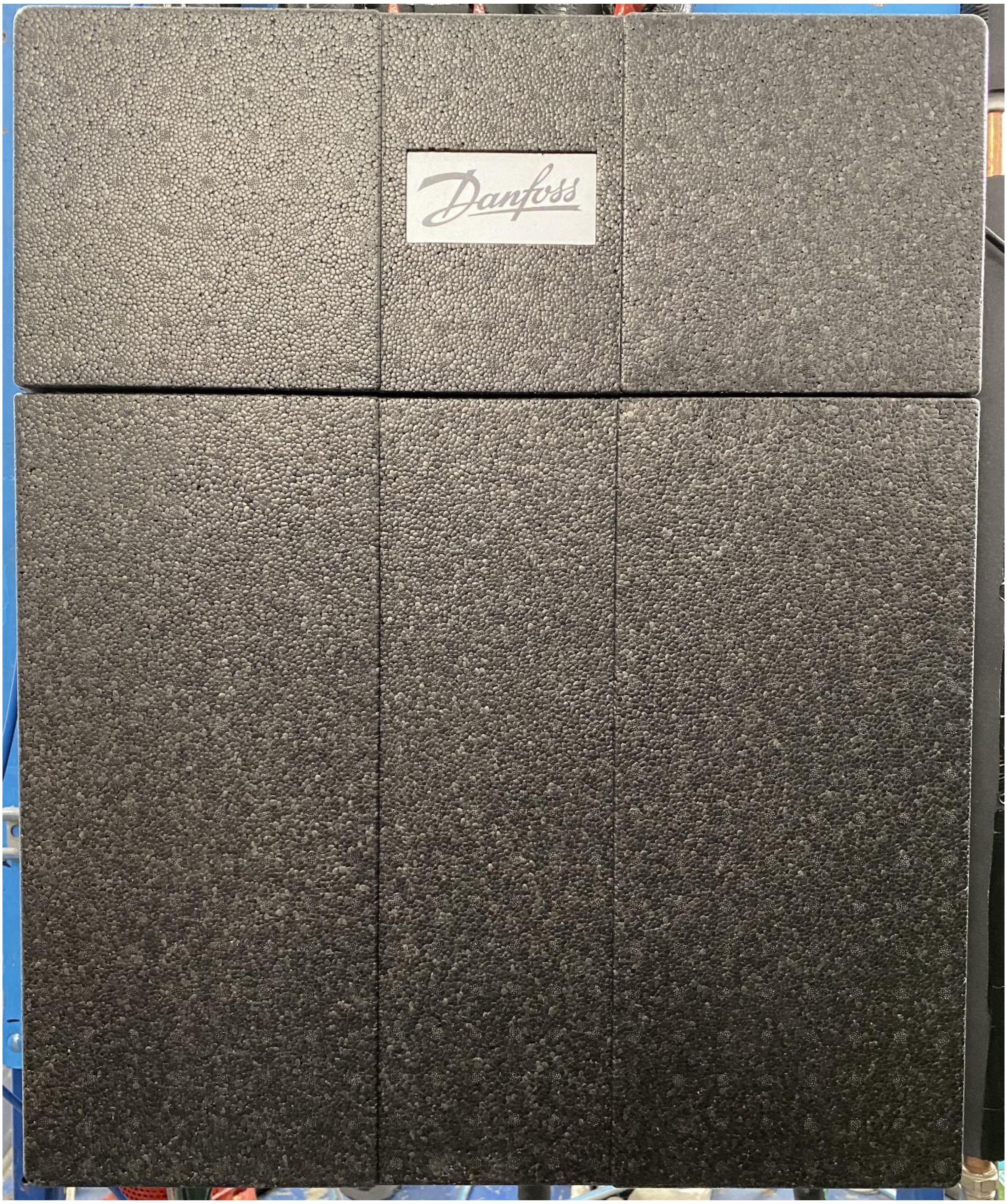



Figure 2 shows the Danfoss VVX-IV 1-5 RAD, installed in the test rig with the cover on.

**Figure 2 Danfoss VVX-IV 1-5 RAD, cover on**



# 3 APPROACH

## 3.1 ABBREVIATIONS

The abbreviations given in Table 3 are used throughout this report.

**Table 3 Abbreviations used**

| Abbreviation | Parameter | Units |
|---|---|---|
| DH | District Heating | - |
| SH | Space Heating | - |
| CWS | Cold Water Supply | - |
| $P_1$ | Heat load – primary side | [kW] |
| $P_2$ | Heat load – space heating system | [kW] |
| $P_3$ | Heat load – domestic hot water | [kW] |
| $t_{10}$ | Temperature at DH supply upstream of 9m HIU supply pipework | [°C] |
| $t_{11}$ | Temperature – primary side flow connection | [°C] |
| $t_{12}$ | Temperature – primary side return connection | [°C] |
| $t_{21}$ | Temperature – space heating system return connection | [°C] |
| $t_{22}$ | Temperature – space heating system flow connection | [°C] |
| $t_{31}$ | Temperature – cold water supply | [°C] |
| $t_{32}$ | Temperature – domestic hot water flow from HIU | [°C] |
| $q_1$ | Volume flow – primary side | [$l.s^{-1}$] |
| $q_2$ | Volume flow – space heating system | [$l.s^{-1}$] |
| $q_3$ | Volume flow – domestic hot water | [$l.s^{-1}$] |
| $\Delta p_1$ | Primary pressure drop across entire HIU unit | [bar] |
| $\Delta p_2$ | Pressure drop – space heating system across HIU | [bar] |
| $\Delta p_3$ | Pressure drop – domestic hot water across HIU | [bar] |
| $VWART_{DHW}$ | DHW Volume Weighted Average Return Temperature | [°C] |
| $VWART_{SH}$ | Space Heating Volume Weighted Average Return Temperature | [°C] |
| $VWART_{KWM}$ | Keep-warm Volume Weighted Average Return Temperature | [°C] |
| $VWART_{HEAT}$ | Annual Volume Weighted Average Return Temperature for Heating Period | [°C] |
| $VWART_{NONHEAT}$ | Annual Volume Weighted Average Return Temperature for Non-Heating | [°C] |
| $VWART_{HIU}$ | Total Annual Volume Weighted Return Temperature | [°C] |
| $SH_{PROP}$ | Annual Heating Period | - |
| $NSH_{PROP}$ | Annual Non-Space Heating Period | - |
| DH | District Heating (primary) circuit | - |
| SH | Space Heating circuit | - |
| CWS | Cold Water Supply | - |
| DHW | Domestic Hot Water | - |
| TMV | Thermostatic Mixing Valve | - |
| TRV | Temperature Regulating Valve | - |
| UFH | Under Floor Heating | - |

## 3.2 INSTRUMENTATION USED

Table 4 shows details of the instrumentation used for the tests.

**Table 4 Instrumentation used**

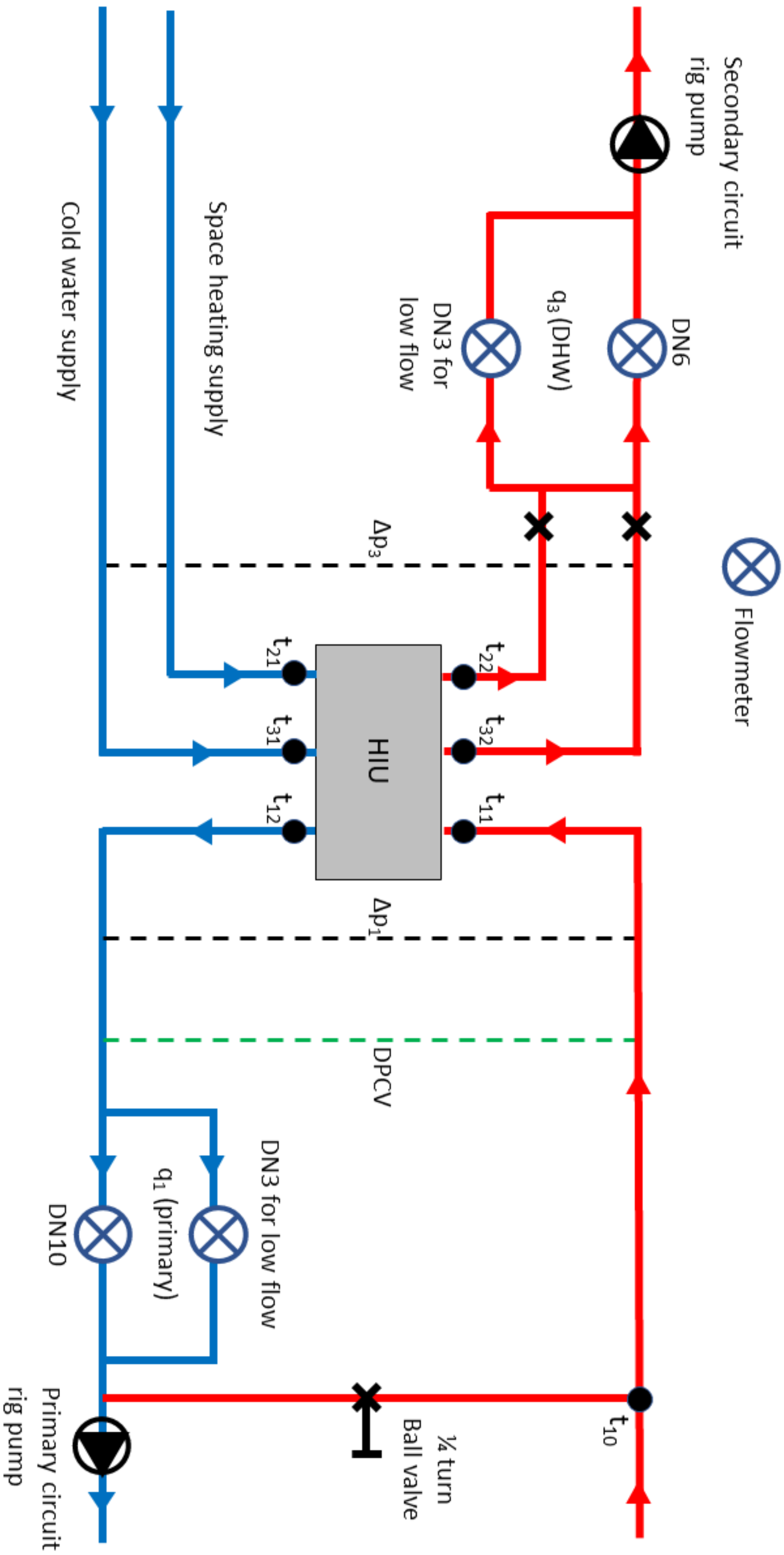
| Instrument | Manufacturer | Range | Units | ID No. | Calibration Due |
|---|---|---|---|---|---|
| Keysight logging system | Keysight | -1 – 90 | °C | 1595<br>1597 | 03-09-22 |
| Static pressure transducer<br>Primary circuit for all thermal tests | Fuji Electric<br>FKPW03V52KCYYOY | 0 – 10 | Bar | 1592 | 12-05-23 |
| Static pressure transducer<br>Secondary circuit for all thermal<br>Pressure test on SH/DHW circuits | Fuji Electric<br>FKPW03V52KCYYOY | 0 – 10 | Bar | 1593 | 12-05-23 |
| Platinum Resistance Thermometers (PRTs)*<br>Used for measuring the inlet/outlet parameters during the testing | TC Ltd<br>4-wire PT100 | 5 – 90 | °C | 1685 | 02-12-22 |
| Platinum Resistance Thermometer (PRT) | Anville Sensors Ltd<br>4-wire PT100 | 5 – 90 | °C | 1685 | 02-12-22 |
| Flowmeter – DH circuit<br>Space heating tests – (1a – 1f)<br>Keep warm tests (4a & 4b) | Siemens<br>MAG 6000/1100 | 0 – 0.07 | $l.s^{-1}$ | 2961 | 28-01-23 |
| Flowmeter – SH circuit<br>Space heating tests – (1a – 1e) | Siemens<br>MAG 6000/1100 | 0 – 0.07 | $l.s^{-1}$ | 1678 | 19-05-23 |
| Flowmeter – SH circuit<br>Space heating tests – (1f) | Danfoss<br>MAG 6000/1100 | 0 – 0.2 | $l.s^{-1}$ | 94 | 18-05-23 |
| Flowmeter – DH circuit<br>Dynamic tests – (2a, 2b, 3a & 3b)<br>Keep warm tests (4a & 4b)<br>DHW response time tests (5a & 5b) | Siemens<br>MAG 6000/1100 | 0 – 0.5 | $l.s^{-1}$ | 2063 | 12-11-22 |
| Flowmeter – DHW circuit<br>Dynamic tests – (2a, 2b, 3a & 3b)<br>Keep warm tests 4a & 4b<br>DHW response time test 5a & 5b | Danfoss<br>MAG 6000/1100 | 0 – 0.2 | $l.s^{-1}$ | 94 | 18-05-23 |
| Differential pressure transducer<br>DH circuit for all thermal tests | Fuji Electric<br>FKCW36V51KCYYAA | 0 – 200 | kPa | 2065 | 22-02-23 |
| Differential pressure transducer<br>SH and DHW circuit for all thermal tests | Fuji Electric<br>FKCW36V51KCYYAA | 0 – 100 | kPa | 367 | 22-02-23 |
| Static pressure transducer<br>Pressure test and unused SH/DHW circuits | Fuji Electric<br>FKCW36V51KCYYAA | 0 – 30 | barg | 1582 | 01-06-23 |
| Stopwatch | RS | | Secs | 183 | 18-01-23 |

*The time constant for these temperature sensors was ≤ 1.5 s.

The calibration certificates for all the instrumentation used during this series of tests are available on request from BSRIA (test@BSRIA.co.uk)

Figure 3 shows a schematic of the test rig layout.

**Figure 3 Schematic of the test rig layout.**



## 3.3 UNCERTAINTY BUDGET

The uncertainty of measurement given in the test regime is shown in Table 5.

**Table 5 Uncertainty budget**

| Parameter | Required Uncertainty | BSRIA Uncertainty |
|---|---|---|
| Static pressure | ±10 kPa | ±0.65 kPa |
| Differential pressure, district heating | *Not supplied* | ±0.06 kPa |
| Differential pressure, domestic hot water | ±1 kPa | ±0.06 kPa |
| Differential pressure, space heating | ±1 kPa | ±0.06 kPa |
| Temperature | ±0.1°C | ±0.02°C |
| Volume flow (≥ 0.06 l/s) | ±1.5% | ±0.0006 l/s |
| Volume flow (< 0.06 l/s) | To be specified in conjunction with each measurement | ±0.0007 l/s |

The uncertainty of the instrumentation used was calculated according to M3003 – The Expression of Uncertainty and Confidence in Measurement. All the instrumentation used in this series of tests was within the required uncertainty quoted above.

## 3.4 RANGE OF TESTS

Table 6 shows the setup of the tests as given in the test regime.

**Table 6 Test setup as given in the test regime**

| Test No. | Test | Static pressure on return | dP across HIU | Primary flow temp | Hot water setpoint | DHW flow rate | DHW power | Space heat output | Space heat flow temp | Space heat return temp |
|---|---|---|---|---|---|---|---|---|---|---|
| | | bar | bar | °C | °C | l/s | kW | kW | °C | °C |
| | | | $dP_1$ | $t_{11}$ | $t_{32}$ | $q_3$ | $P_3$ | $P_2$ | $t_{22}$ | $t_{21}$ |
| **Static tests** | | | | | | | | | | |
| 0a | Static pressure test (same static pressure on both flow and return connections) | 1.43 times rated value | | 70 | 50 | - | - | - | n/a | n/a |
| 1a | Space Heating 1 kW | 3.0 | 0.5 | 70 | 55 | - | - | 1 | 60 | 40 |
| 1b | Space Heating 2 kW | 3.0 | 0.5 | 70 | 55 | - | - | 2 | 60 | 40 |
| 1c | Space Heating 4 kW | 3.0 | 0.5 | 70 | 55 | - | - | 4 | 60 | 40 |
| 1d | Space Heating 1 kW | 3.0 | 0.5 | 60 | 50 | - | - | 1 | 45 | 35 |
| 1e | Space Heating 2 kW | 3.0 | 0.5 | 60 | 50 | - | - | 2 | 45 | 35 |
| 1f | Space Heating 4 kW | 3.0 | 0.5 | 60 | 50 | - | - | 4 | 45 | 35 |
| **Dynamic tests** | | | | | | | | | | |
| 2a | DHW only DH 70°C flow | 3.0 | 0.5 | 70 | 55 | see DHW test profile | see DHW test profile | - | 60 | - |
| 2b | DHW only DH 60°C flow | 3.0 | 0.5 | 60 | 50 | | | - | 45 | - |
| 3a | Low flow DHW, DH 70°C flow | 3.0 | 0.5 | 70 | 55 | 0.02 | Record value | - | 60 | - |
| 3b | Low flow DHW, DH 60°C flow | 3.0 | 0.5 | 60 | 50 | 0.02 | Record value | - | 45 | - |
| 4a | Keep-warm, DH 70°C flow | 3.0 | 0.5 | 70 | 55 | 0 | 0 | - | 60 | - |
| 4b | Keep-warm, DH 60°C flow | 3.0 | 0.5 | 60 | 50 | 0 | 0 | - | 45 | - |
| 5a | DHW response time | 3.0 | 0.5 | 70 | 55 | 0.13 | Record value | - | 60 | - |
| 5b | DHW response time | 3.0 | 0.5 | 60 | 50 | 0.13 | Record value | - | 45 | - |

Table 7 shows the reporting structure of the tests as given in the test regime. A summary of findings is shown in the right-hand column, see section 4 for the full test results.

**Table 7 Test reporting structure as given in the test regime**

| Test | Description | Reporting | Pass/Fail |
|---|---|---|---|
| **Static Tests** | | | |
| 0 | Pressure tests | Pass/Fail as to whether HIU manages pressure test without leaks or damage. | Pass |
| 1a | Space Heating 1 kW, 60/40°C secondary | $t_{11}$-primary flow temperature<br>$t_{12}$-primary return temperature.<br>Plot of key metrics over duration of test.<br>**Note:** Outputs used as input data to 'High Temperature' Space Heating Volume Weighted Average Return Temperature calculation. | N/A |
| 1b | Space Heating 2 kW, 60/40°C secondary | | N/A |
| 1c | Space Heating 4 kW, 60/40°C secondary | | N/A |
| 1d | Space Heating 1 kW, 45/35°C secondary | $t_{11}$-primary flow temperature<br>$t_{12}$-primary return temperature<br>Plot of key metrics over duration of test.<br>**Note:** Outputs used as input data to 'Low Temperature' Space Heating Volume Weighted Average Return Temperature calculation. | N/A |
| 1e | Space Heating 2 kW, 45/35°C secondary | | N/A |
| 1f | Space Heating 4 kW, 45/35°C secondary | | N/A |
| **Dynamic Tests** | | | |
| 2a | DHW only, DH 70°C flow;<br>55°C DHW | Pass/Fail on DHW (at $t_{32}$) exceeding 65.0°C (to 1 decimal point) for more than 10 consecutive seconds. State the maximum and minimum DHW temperatures over the period of the test when there is a DHW flow.<br>Assessment of scaling risk as per criteria detailed in 2.26.<br>**Note:** Outputs used as input data to 'High Temperature' Domestic Hot Water Weighted Average Return Temperature calculation.<br>Plot $t_{32}$, $t_{31}$, $q_3$, $t_{12}$ $q_1$ | Pass |
| 2b | DHW only, DH 60°C flow;<br>50°C DHW | State the maximum and minimum DHW temperatures over the period of the test when there is a DHW flow.<br>Plot $t_{32}$, $t_{31}$, $q_3$, $t_{12}$ $q_1$<br>**Note:** Outputs used as input data to 'Low Temperature' Domestic Hot Water Weighted Average Return Temperature calculation. | N/A |
| 3a | Low flow DHW, DH 70°C flow; 55°C DHW | Pass/Fail on DHW (at $t_{32}$) exceeding 65.0°C (1 decimal place) for more than 10 consecutive seconds.<br>Comment on ability to deliver DHW at low flow based on DHW temperature reaching at least 45.0°C (1 decimal place) at the end of the 180 second period of low flow DHW.<br>Comment on ability to deliver stable DHW flow temperature (at $t_{32}$), defined as ability to maintain 55.0 +/-3.0°C (1 decimal place) during the last 60 seconds of the test. Maximum temperature achieved and +/-°C variance around 55.0°C (1 decimal place) to be stated. Assessment of scaling risk as per criteria detailed in 2.26. Plot of key metrics for 60 seconds of 0.13 l/s flow and the subsequent 180 seconds of 0.02 l/s DHW flow. | Pass |

| | | | |
|---|---|---|---|
| 3b | Low flow DHW, DH 60°C flow; 50°C DHW | Comment on ability to deliver DHW at low flow rate based on DHW temperature reaching at least 45°C (one decimal place) at the end of the 180 second period of low flow DHW. Comment on ability to deliver stable DHW flow temperature (at $t_{32}$), defined as ability to maintain 50.0 +/-3°C (1 decimal place) during the last 60 seconds of the test. Maximum temperature achieved and +/-°C variance around 50.0°C (1 decimal place) to be stated.<br>Plot of key metrics for 60 seconds of 0.13 l/s flow and the subsequent 180 seconds of 0.02 l/s DHW flow.<br>Maximum temperature achieved and +/-°C variance around 50.0°C (1 decimal place) to be stated. | N/A |
| 4a | Keep-warm, DH 70°C flow; 55°C DHW | Assessment of whether valid keep-warm operation, based on 5a response time criteria: Pass / Fail.<br>Observation on the operation of the HIU during keep-warm.<br>Assessment of scaling risk, based on duration of temperatures in excess of 55.0°C (one decimal place). Plot temperature t10.<br>Comment on HIU keep-warm controls options.<br>Plot of key metrics over duration of test.<br>State average heat load for the duration of the test.<br>State average primary flowrate for the duration of the test.<br>**Note:** Outputs used as input data to 'High Temperature' Keep-warm Volume Weighted Average Return Temperature calculation. | Pass |
| 4b | Keep-warm, DH 60°C flow; 50°C DHW | Assessment of whether valid keep-warm operation, based on 5b response time criteria: Pass / Fail.<br>Observation on the operation of the HIU during keep-warm.<br>Assessment of scaling risk, based on duration of temperatures in excess of 55.0°C (one decimal place).<br>Plot temperature t10.<br>Comment on HIU keep-warm controls options.<br>Plot of key metrics over duration of test.<br>State average heat load for the duration of the test.<br>State average primary flowrate for the duration of the test.<br>**Note:** Outputs used as input data to 'Low Temperature' Keep-warm Volume Weighted Average Return Temperature calculation. | Pass |
| 5a | DHW response time, DH 70°C flow; 55°C DHW | Pass/Fail on DHW (at $t_{32}$) exceeding 65.0°C (1 decimal place) for more than 10 consecutive seconds. State time to achieve a DHW temperature 45.0°C (1 decimal place) and not subsequently drop below 42.0°C (1 decimal place).'<br>Plot $t_{32}$, $t_{31}$, $q_3$, $t_{12}$, $q_1$ over duration of test. | Pass |
| 5b | DHW response time, DH 60°C flow; 50°C DHW | Pass/Fail on DHW (at $t_{32}$). State time to achieve a DHW temperature 45.0°C (1 decimal place) and not subsequently drop below 42.0°C (1 decimal place).<br>Plot $t_{32}$, $t_{31}$, $q_3$, $t_{12}$, $q_1$ over duration of test. | Pass |

# 4 TEST PROCEDURE

The average deviation of $t_{31}$ (CWS) during test 2a, 2b, 3a,3b, 5a and 5b remained within ±0.5°C of the stipulated 10°C as required by the test regime (see paragraph2.11 of the test regime).

## 4.1 TESTS 1A TO 1F

Once the rig was running, the space heating tests were allowed to stabilise at the required power output for the particular test. Once stable conditions had been achieved, the test was logged at a rate of 1 Hz for a minimum period of 300 seconds.

## 4.2 TESTS 2A AND 2B

Prior to the test being carried out, the rig was running at the required stable conditions for a minimum of 120 seconds. After this period, the DHW draw off test was carried out as per the flow regime specified in the test method. The flow rates were controlled using a manifold of three control valves set to the correct flows. The data was logged at a rate of 1 Hz.

## 4.3 TESTS 3A AND 3B

Prior to the tests being carried out, the rig was running at the required stable conditions for a minimum of 120 seconds. After this period, the DHW flow was reduced to 0.02 l/s as required by the test regime and logged for 180 seconds at a rate of 1 Hz.

## 4.4 TESTS 4A AND 4B

Prior to the test being carried out, the rig was running at the required stable conditions for a minimum of 120 seconds. After this period, the DHW flow was turned off and left for a minimum of 8 hours to establish “keep warm” conditions. The keep warm mode for this HIU was a trickle flow through the primary circuit. During this test, the primary flow was diverted through a DN3 flowmeter so that the trickle flow could be measured. The data was logged at a rate of 1 Hz throughout the duration of the 8-hour test period.

## 4.5 TESTS 5A AND 5B

These tests were carried out while the HIU was still in “keep warm” mode after the 8-hour keep warm test. With the data still being logged at a rate of 1 Hz, the DHW flow was immediately brought back to 0.13 l/s.

# 5 TEST RESULTS

During all the tests, the ambient temperature within the vicinity of the HIU being tested was within the tolerance of 20°C ±5°C as specified in the test regime. Charts of the key metrics for the thermal tests are given in Appendix A. For all tests, this HIU did not need to be connected to mains electricity.

## 5.1 PRESSURE TEST – 0A

The DHW circuit and the space heating circuit were pressurised to 1.5 bar. The primary circuit was pressurised to 1.43 times the rated maximum static pressure of 10 bar (test pressure 14.3bar). This pressure was held for 30 minutes. After the 30-minute test period, the connections and fittings on the HIU were inspected for leaks and any signs of deformation. During the 30-minute period, there were no leaks or signs of deformation.

Result – Pass.

## 5.2 SPACE HEATING TESTS – 1A, 1B, 1C, 1D, 1E AND 1F

- 1a – DH inlet 70°C, heating return at 40°C and a flow set to achieve 1kW heating duty
- 1b – DH inlet 70°C, heating return at 40°C and a flow set to achieve 2kW heating duty
- 1c – DH inlet 70°C, heating return at 40°C and a flow set to achieve 4kW heating duty
- 1d – DH inlet 60°C, heating return at 35°C and a flow set to achieve 1kW heating duty
- 1e – DH inlet 60°C, heating return at 35°C and a flow set to achieve 2kW heating duty
- 1f – DH inlet 60°C, heating return at 35°C and a flow set to achieve 4kW heating duty

For tests 1a to 1c, the space heating outlet temperature was set to achieve 60°C (±0.5°C) during the 4kw test. For tests 1d to 1f, the space heating outlet temperature was set to achieve 45°C (±0.5°C) during the 4kw test. Table 8 shows a summary of the results for the space heating. Table 9 shows the uncertainty of measurement for the space heating tests.

**Table 8 Results from the static tests**

| Test | District Heating Circuit | | | | | Space Heating Circuit | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $t_{11}$ (°C) | $t_{12}$ (°C) | $q_1$ (l/s) | $\Delta p_1$ (kPa) | $P_1$ (kW) | $T_{21}$ (°C) | $T_{22}$ (°C) | $q_2$ (l/s) | $P_2$ (kW) |
| 1a | 70.29 | 39.64 | 0.009 | 50.39 | 1.14 | 39.99 | 59.89 | 0.012 | 0.98 |
| 1b | 70.00 | 40.13 | 0.017 | 50.15 | 2.08 | 40.04 | 59.21 | 0.025 | 1.97 |
| 1c | 70.04 | 40.40 | 0.034 | 50.62 | 4.18 | 40.03 | 59.95 | 0.049 | 4.01 |
| 1d | 60.03 | 34.81 | 0.011 | 50.05 | 1.15 | 35.02 | 47.43 | 0.020 | 1.03 |
| 1e | 59.93 | 34.88 | 0.021 | 50.15 | 2.19 | 34.99 | 45.90 | 0.046 | 2.08 |
| 1f | 60.07 | 35.00 | 0.041 | 50.31 | 4.27 | 35.09 | 44.93 | 0.100 | 4.07 |

**Table 9 Uncertainty budget for tests 1a to 1f**

| Test | Uncertainty Budget District Heating Circuit | | | | | Uncertainty Budget Space Heating Circuit | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $t_{11}$ (°C) | $t_{12}$ (°C) | $q_1$ (l/s) | $\Delta p_1$ (kPa) | $P_1$ (kW) | $T_{21}$ (°C) | $T_{22}$ (°C) | $q_2$ (l/s) | $P_2$ (kW) |
| 1a to 1e | ±0.018 | ±0.018 | ±0.0006 | ±0.031 | ±0.06 | ±0.018 | ±0.018 | ±0.0006 | ±0.06 |
| 1f | ±0.018 | ±0.018 | ±0.0006 | ±0.031 | ±0.06 | ±0.018 | ±0.018 | ±0.0007 | ±0.04 |

## 5.3 DYNAMIC TESTING OF THE HIU OPERATION – 2A AND 2B

### 5.3.1 Test 2a

Test 2a was carried out with the DH water temperature set to 70°C and the cold-water supply to the DHW circuit at 10°C. The DHW outlet temperature was set to achieve 55.0°C (±0.5°C) at a DHW flow rate of 0.130 l/s, prior to the test.

During test 2a:

- The DHW temperature did not exceed 65°C at any point during the test
- The maximum DHW temperature was 58.1°C
- The minimum DHW temperature was 52.4°C
- Details of the scaling risk are given in Table 10
- T31 (CWS) had an average value of 10.16°C and a standard deviation of 0.09

**Result – Pass**

### 5.3.2 Test 2b

Test 2b was carried out with the DH water temperature set to 60°C and the cold-water supply to the DHW circuit at 10°C. The DHW outlet temperature was set to achieve 50.0°C (±0.5°C) at a DHW flow rate of 0.130 l/s, prior to the test.

During test 2b:

- The maximum DHW temperature was 53.1°C
- The minimum DHW temperature was 49.0°C
- T31 (CWS) had an average value of 9.99°C and a standard deviation of 0.09

**Result – There is no pass/fail criteria for this test.**

## 5.4 LOW FLOW DHW TESTS – 3A AND 3B

### 5.4.1 Test 3a

Test 3a was carried out with the DH water temperature set to 70°C (±0.5°C) and the cold-water supply to the DHW circuit at 10°C (±0.5°C). The DHW outlet temperature setpoint remained at the same position, set to achieve 55.0 (±0.5°C) at a DHW flow rate of 0.130 l/s. The low DHW flow rate was reduced to 0.02 l/s as required by the test regime.

During test 3a:

- The DHW temperature did not exceed 65°C at any point during the test
- The HIU was able to deliver DHW above 45°C at the end of the 180 second test
- During the last 60 seconds of the test the DHW temperature averaged 56.2°C and ranged from 56.4°C to 56.2°C so the results were within the stated tolerance of 55.0°C ±3°C during this time period.
- The DHW maximum and minimum outlet temperatures were 58.4.8°C and 54.9°C respectively during the 180 second test.
- $T_{31}$ (CWS) had an average value of 10.07°C and a standard deviation of 0.05
- Details of the scaling risk are given in Table 10

**Result – Pass**

### 5.4.2 Test 3b

Test 3b was carried out with the DH water temperature set to 60°C (±0.5°C) and the cold-water supply to the DHW circuit at 10°C (±0.5°C). The DHW outlet temperature setpoint remained at the same position, set to achieve 50.0 (±0.5°C) at a DHW flow rate of 0.130 l/s. The low DHW flow rate was reduced to 0.02 l/s as required by the test regime.

During test 3b:

- The HIU was able to deliver DHW above 45°C at the end of the 180 second test
- During the last 60 seconds of the test the DHW temperature averaged 51.8°C and ranged from 51.9°C to 51.8°C so the results were within the stated tolerance of 50.0°C ±3°C during this time period.
- The DHW maximum and minimum outlet temperatures were 53.8°C and 50.8°C respectively during the 180 second test.
- $T_{31}$ (CWS) had an average value of 10.03°C and a standard deviation of 0.05

**Result – There is no pass/fail criteria for this test.**

## 5.5 KEEP WARM TESTS – 4A AND 4B

The keep warm function was a trickle flow on the DH circuit as can be seen on the charts in Appendix A.

### 5.5.1 Test 4a

Test 4a was carried out with the DH water temperature set to 70°C (±0.5°C) and the cold-water supply to the DHW circuit at 10°C (±0.5°C). The DHW outlet temperature setpoint remained at the same position, set to achieve 55.0 (±0.5°C) at a DHW flow rate of 0.130 l/s. The HIU was running at these conditions for at least 2 minutes before this test was carried out.

Once the keep warm function had stabilised (approximately 10,000 seconds into the test), the average $t_{11}$ temperature for the remainder of the test (18,800 seconds) was 50.1°C varying between 49.3°C and 51.5°C. The average $t_{12}$ temperature during this same period was 43.5°C varying between 43.0°C and 43.9°C.

During test 4a:

- The average heat load during the 8-hour keep warm period was 28 W
- The average primary flow rate during the 8-hour keep warm period was 3.7 l/h
- Details of the scaling risk are given in Table 10

**Based on the results for the DHW response time during test 5a, the HIU does perform a valid keep warm operation.**

### 5.5.2 Test 4b

Test 4b was carried out with the DH water temperature set to 60°C (±0.5°C) and the cold-water supply to the DHW circuit at 10°C (±0.5°C). The DHW outlet temperature setpoint remained at the same position, set to achieve 50.0 (±0.5°C) at a DHW flow rate of 0.130 l/s. The HIU was running at these conditions for at least 2 minutes before this test was carried out.

Once the keep warm function had stabilised (approximately 6,000 seconds into the test), the average $t_{11}$ temperature for the remainder of the test (22,800 seconds) was 46.6°C varying between 44.1°C and 48.0°C. The average $t_{12}$ temperature during this same period was 41.5°C varying between 40.5°C and 43.5°C.

- The average heat load during the 8-hour keep warm period was 34 W
- The average primary flow rate during the 8-hour keep warm period was 5.2 l/h
- Details of the scaling risk are given in Table 10

**Based on the results for the DHW response time during test 5b, the HIU does perform a valid keep warm operation.**

## 5.6 DHW RESPONSE TIME – 5A AND 5B

For the DHW tests, the HIU does not need mains electrical power.

### 5.6.1 Test 5a

As this HIU has a trickle flow keep warm mode, the DHW draw-off could be carried at any point after the 8-hour test period. The DHW isolation valve was opened to achieve 0.130 l/s instantly.

During test 5a:

- The DHW temperature did not exceed 65.0°C during the test
- The DHW achieved 45.0°C in 4 seconds from the first recorded non-zero DHW flow reading
- The DHW temperature did not subsequently drop below 42.0°C

Not exceeding 65.0°C during the test – Pass
Achieving 45°C DHW within 15 seconds – Pass
DHW temperature not subsequently dropping below 42.0°C – Pass

**Overall result – Pass**

### 5.6.2 Test 5b

As this HIU has a trickle flow keep warm mode, the DHW draw-off could be carried at any point after the 8-hour test period. The DHW isolation valve was opened to achieve 0.130 l/s instantly.

During test 5b:

- The DHW achieved 45.0°C in 7 seconds from the first recorded non-zero DHW flow reading
- The DHW temperature did not subsequently drop below 42.0°C

Achieving 45°C DHW within 15 seconds – Pass
DHW temperature not subsequently dropping below 42.0°C – Pass

**Overall result – Pass**

## 5.7 TOTAL SCALING RISK ASSESSMENT

The scaling risk criteria is given in section 2.26 of the test regime. Table 10 gives details of the scaling risk associated with this HIU. If any of the factors given in Table 10 occur, then there is an increased scaling risk of the DHW plate in hard water areas.

**Table 10 Total scaling risk assessment**

| **Has the HIU got a TMV or TRV on the output of the DHW plate heat exchanger?** | **No** | |
|---|---|---|
| | **Test** | |
| | 2a | 3a |
| $t_{32}$ above 60°C for more than 5 seconds | No | No |
| $t_{12}$ exceeds 55°C at any point of the test | No | No |
| | 4a | 4b |
| $t_{12}$ exceeds 50°C at any time | No | No |

## 5.8 VOLUME WEIGHTED AVERAGE RETURN TEMPERATURE

The Volume Weighted Average Return Temperature (VWART) results are given in Appendix B.

# APPENDIX A: DATA CHARTS

**Figure 4 Results for test 1a: 1kW Space heating – DH 70°C supply**

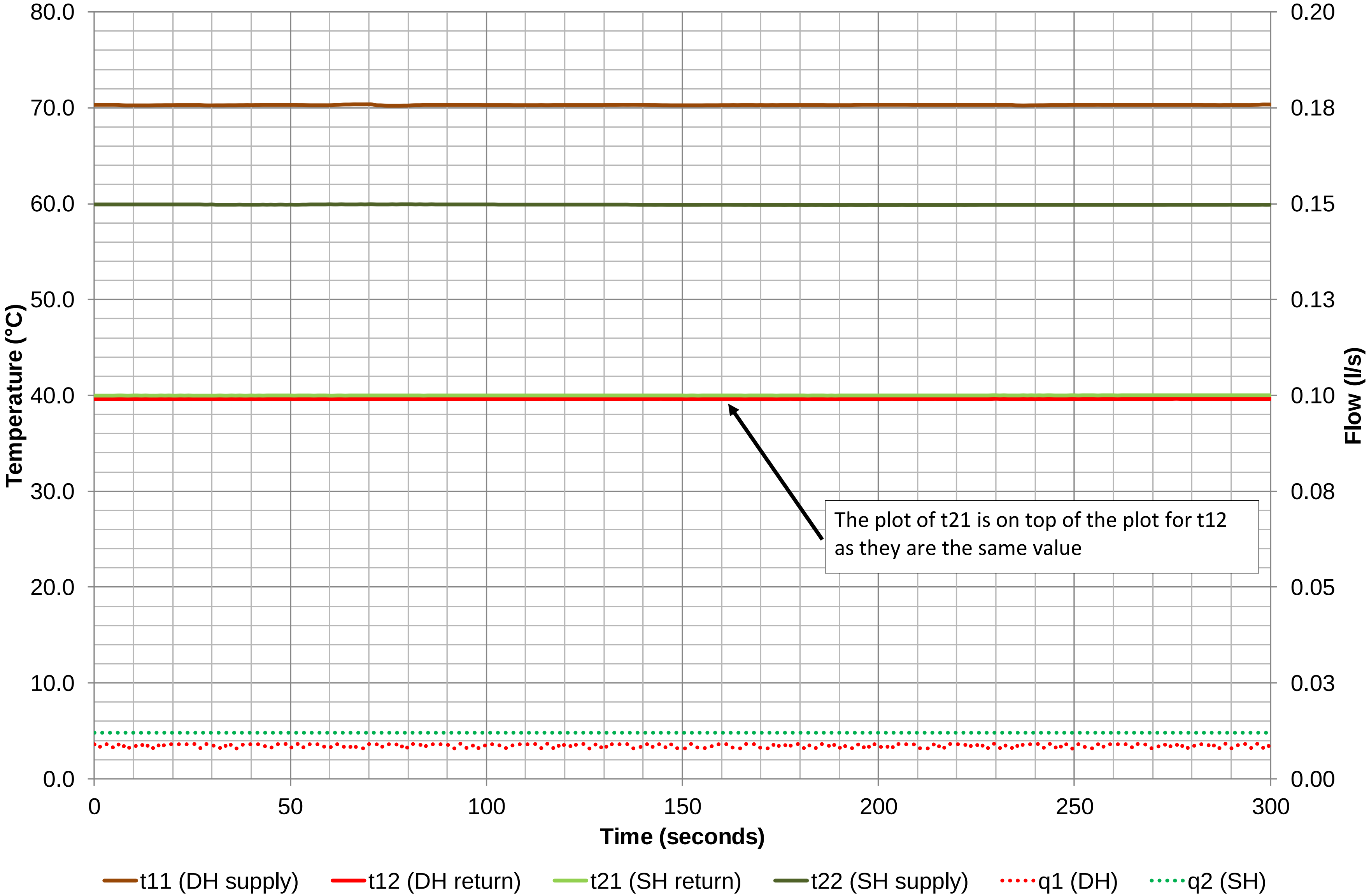


**Figure 5 Results for test 1b: 2kW Space heating – DH 70°C supply**

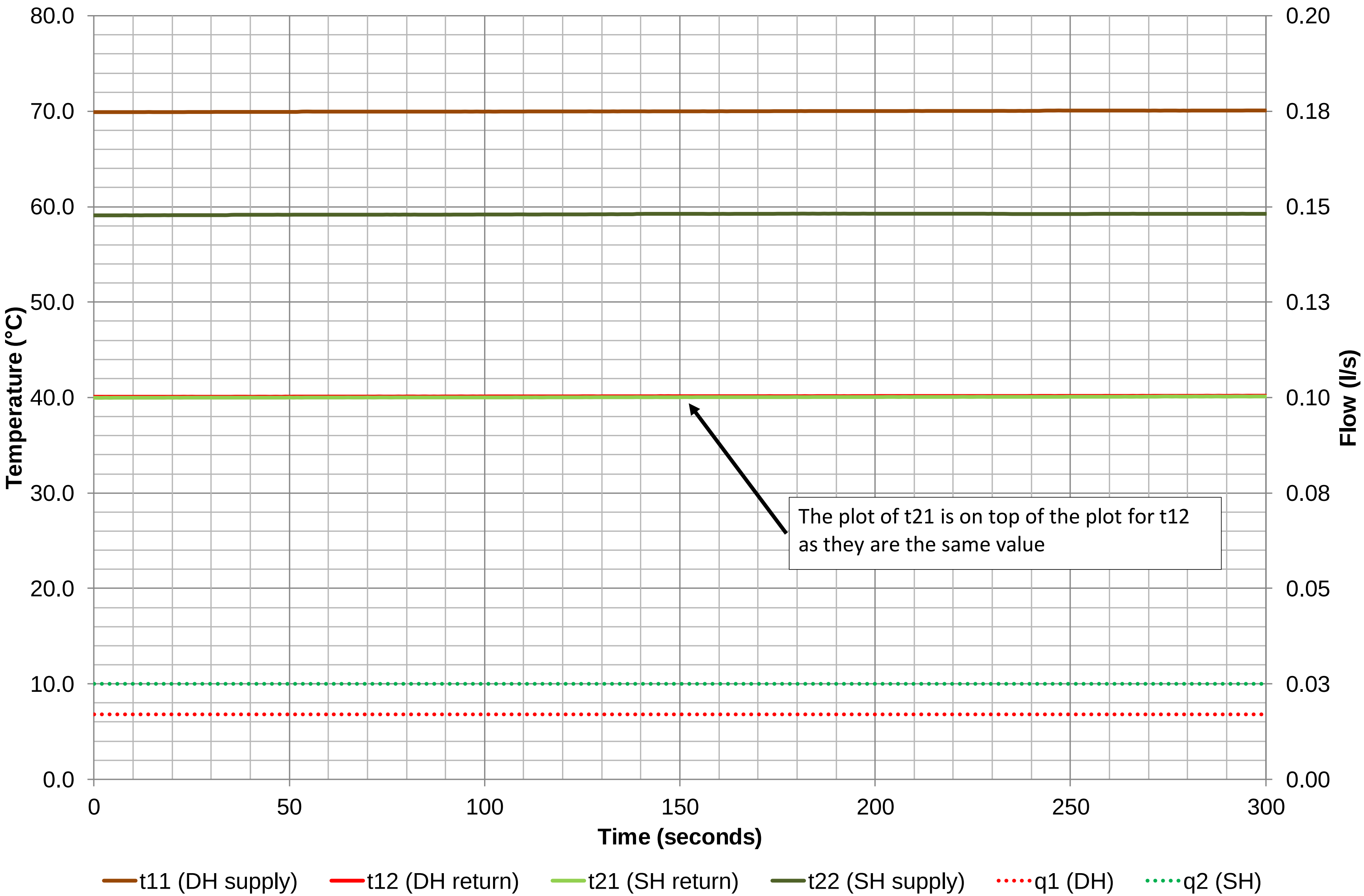


**Figure 6 Results for test 1c: 4kW Space heating – DH 70°C supply**

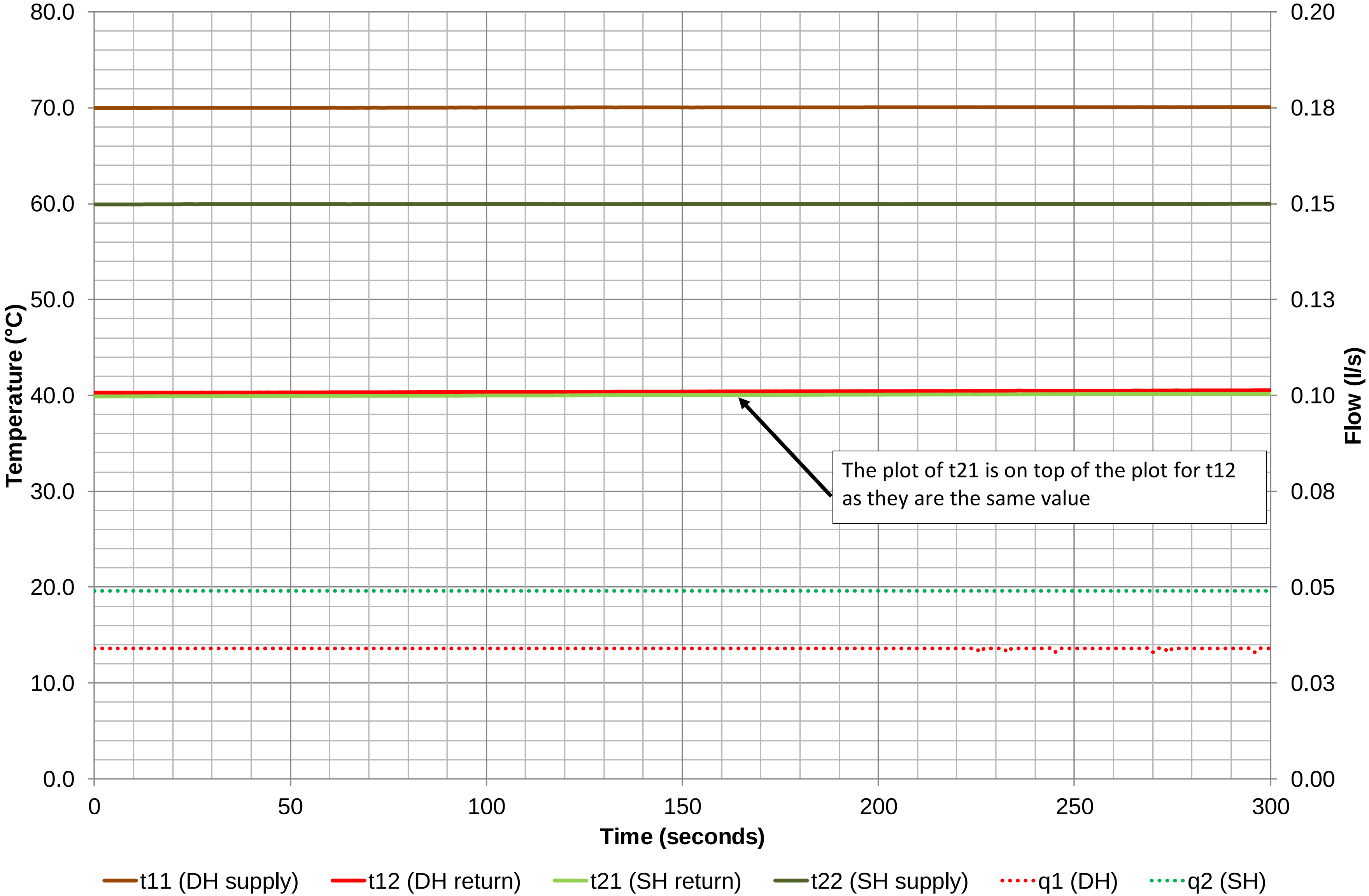


**Figure 7 Results for test 1d: 1kW Space heating – DH 60°C supply**

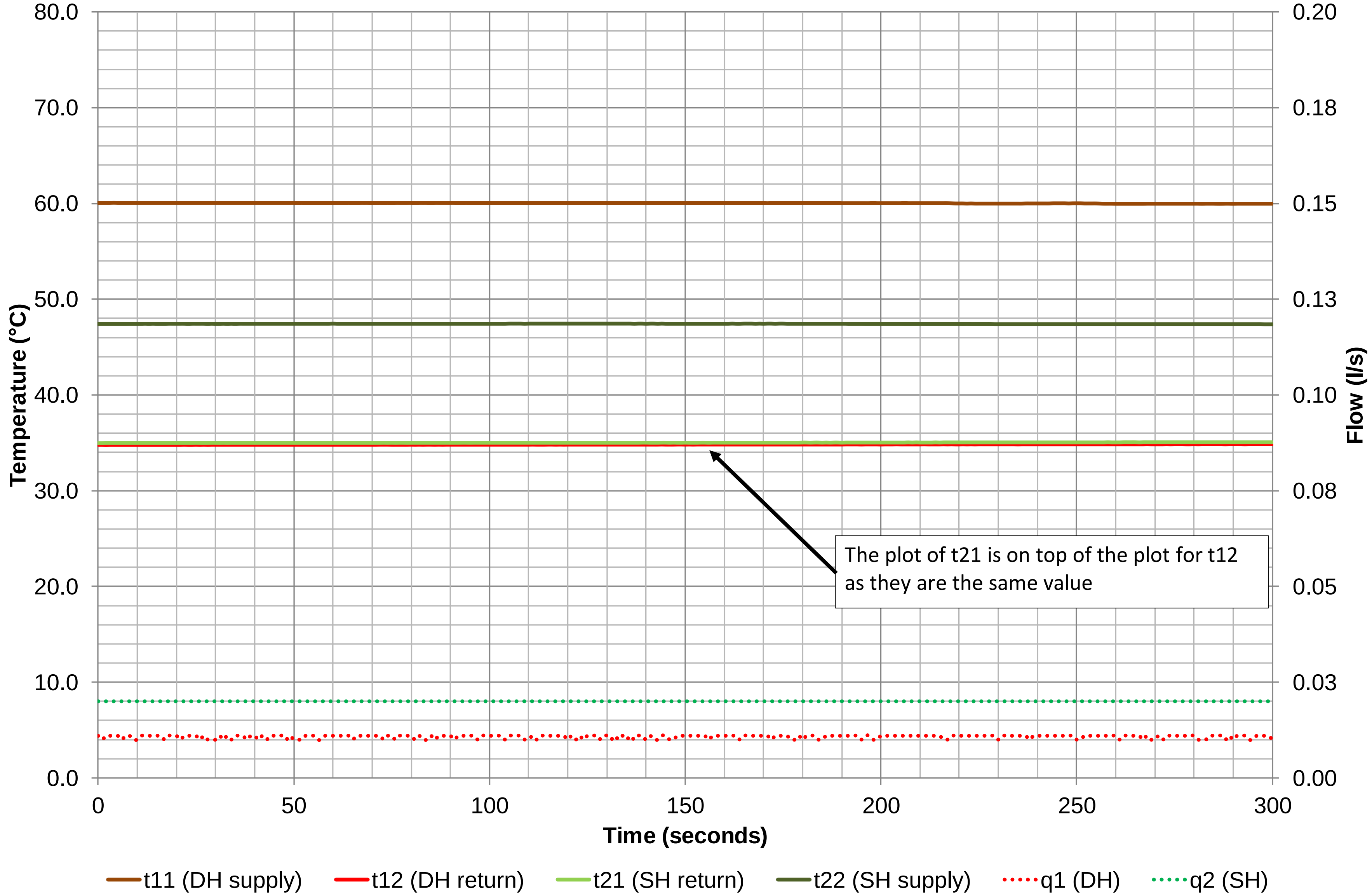


**Figure 8 Results for test 1e: 2kW Space heating – DH 60°C supply**

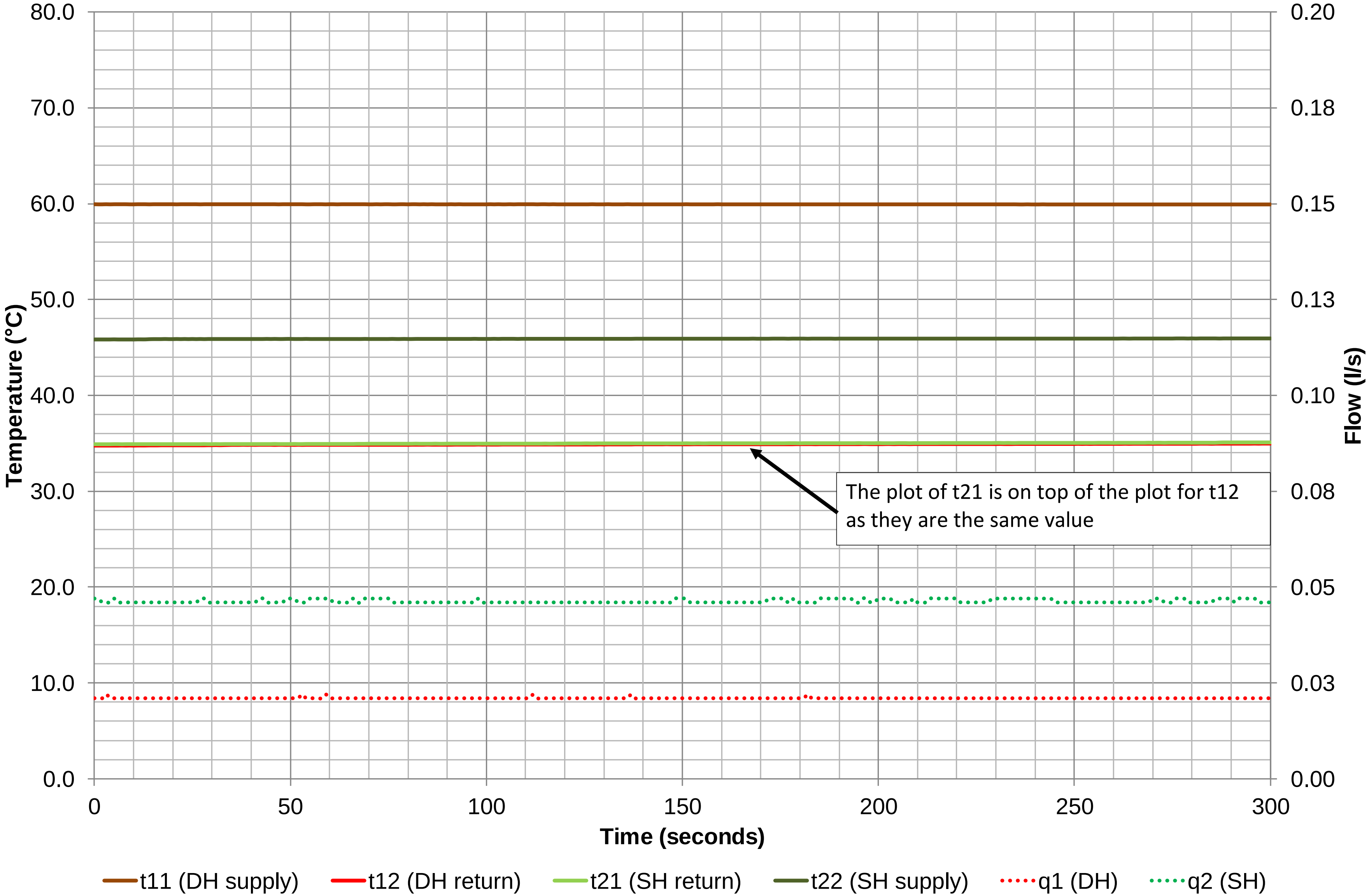


**Figure 9 Results for test 1f: 4kW Space heating – DH 60°C supply**

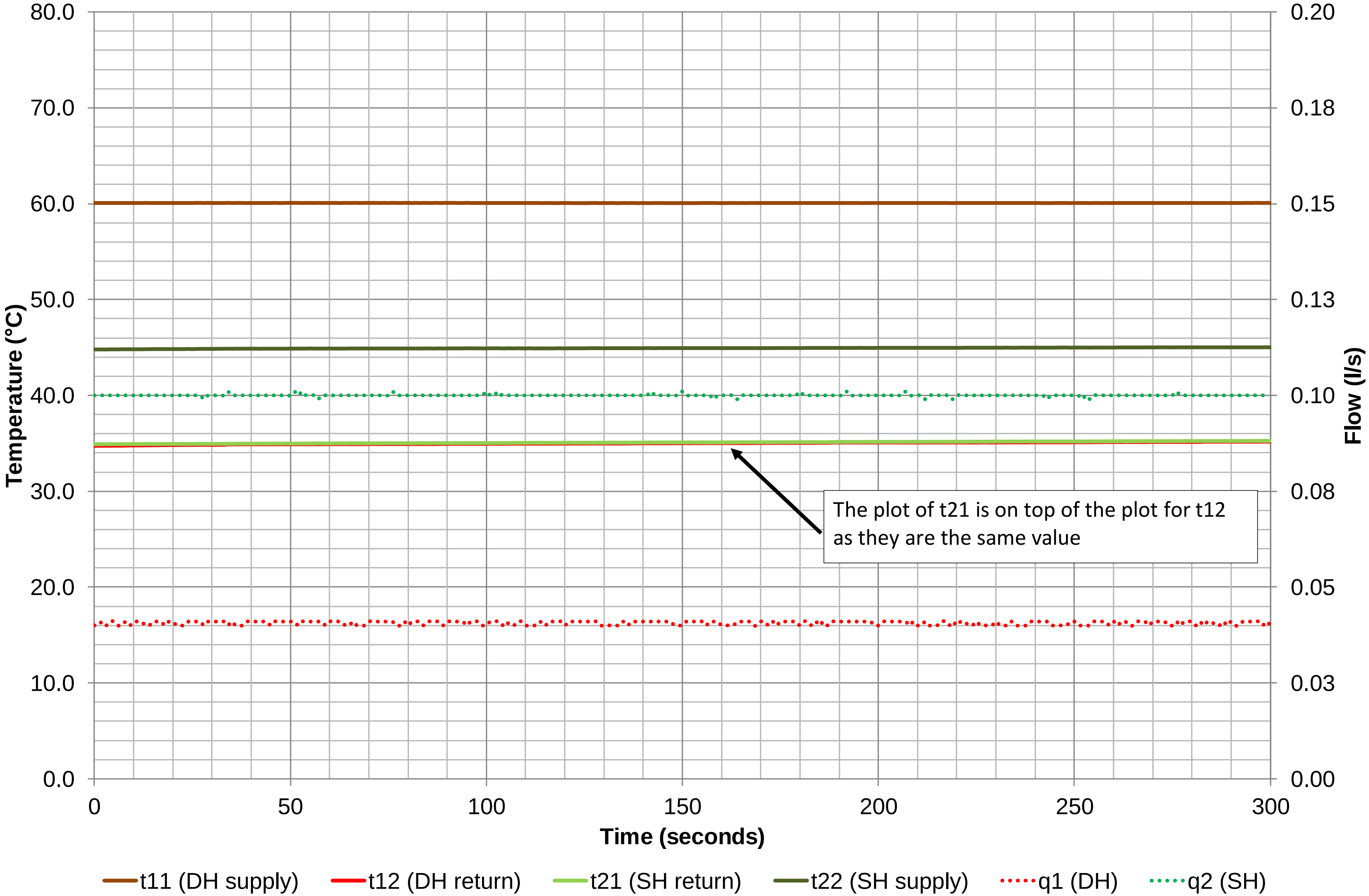


**Figure 10 Results for test 2a: DHW dynamic test – DH 70°C supply**

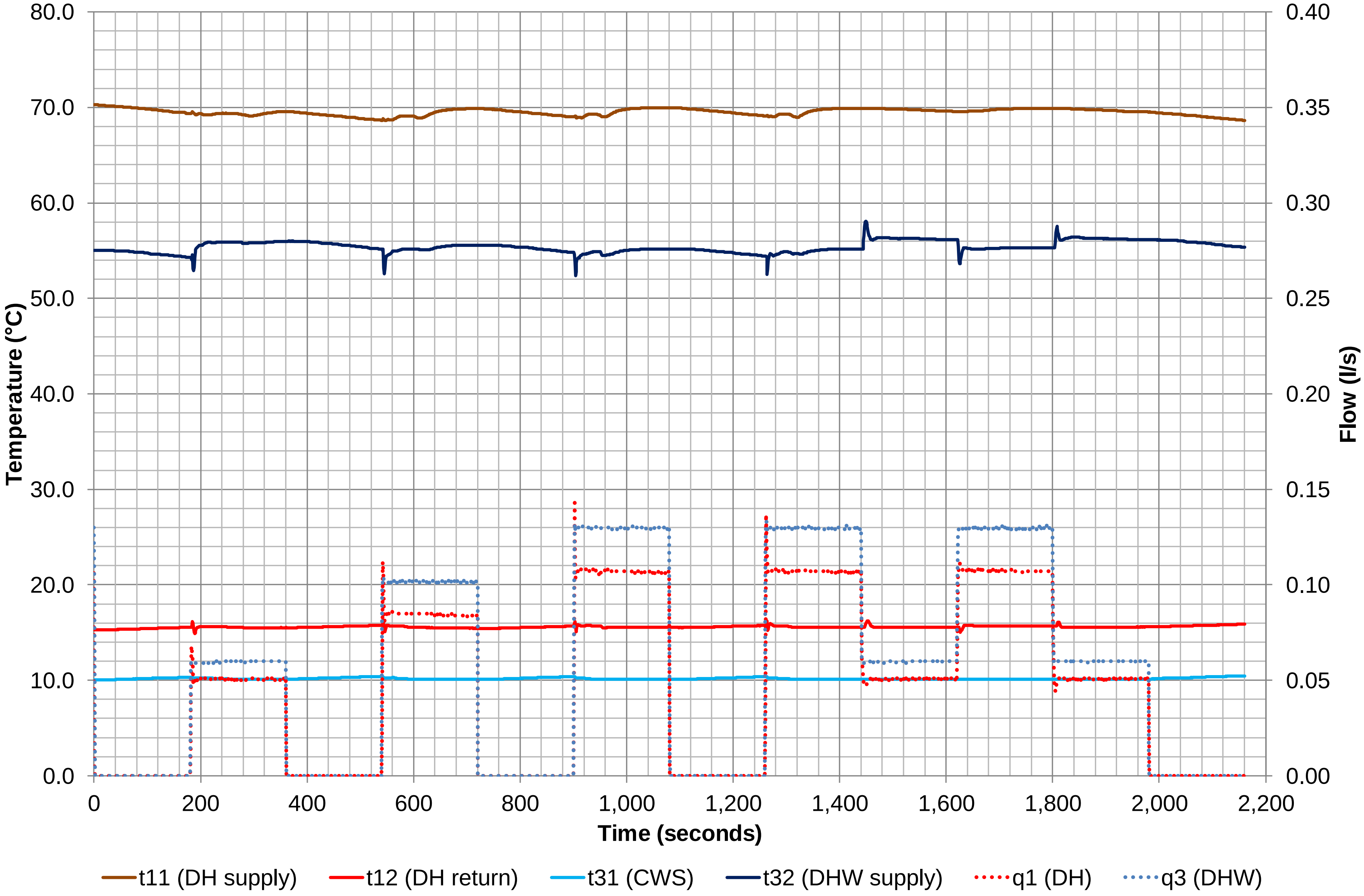


**Figure 11 Results for test 2b: DHW dynamic test – DH 60°C supply**

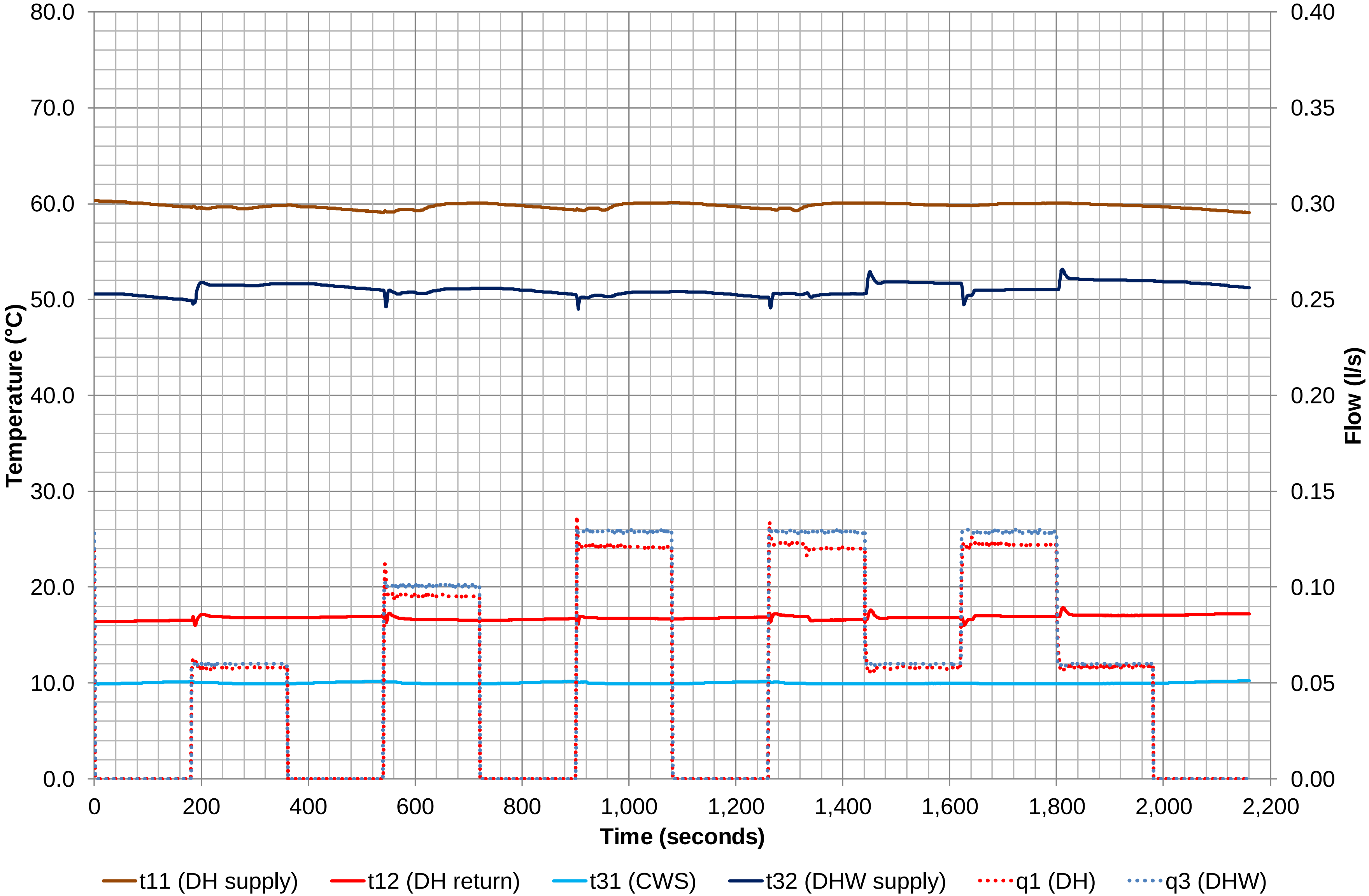


**Figure 12 Results for test 3a: Low flow DHW test – DH 70°C supply**

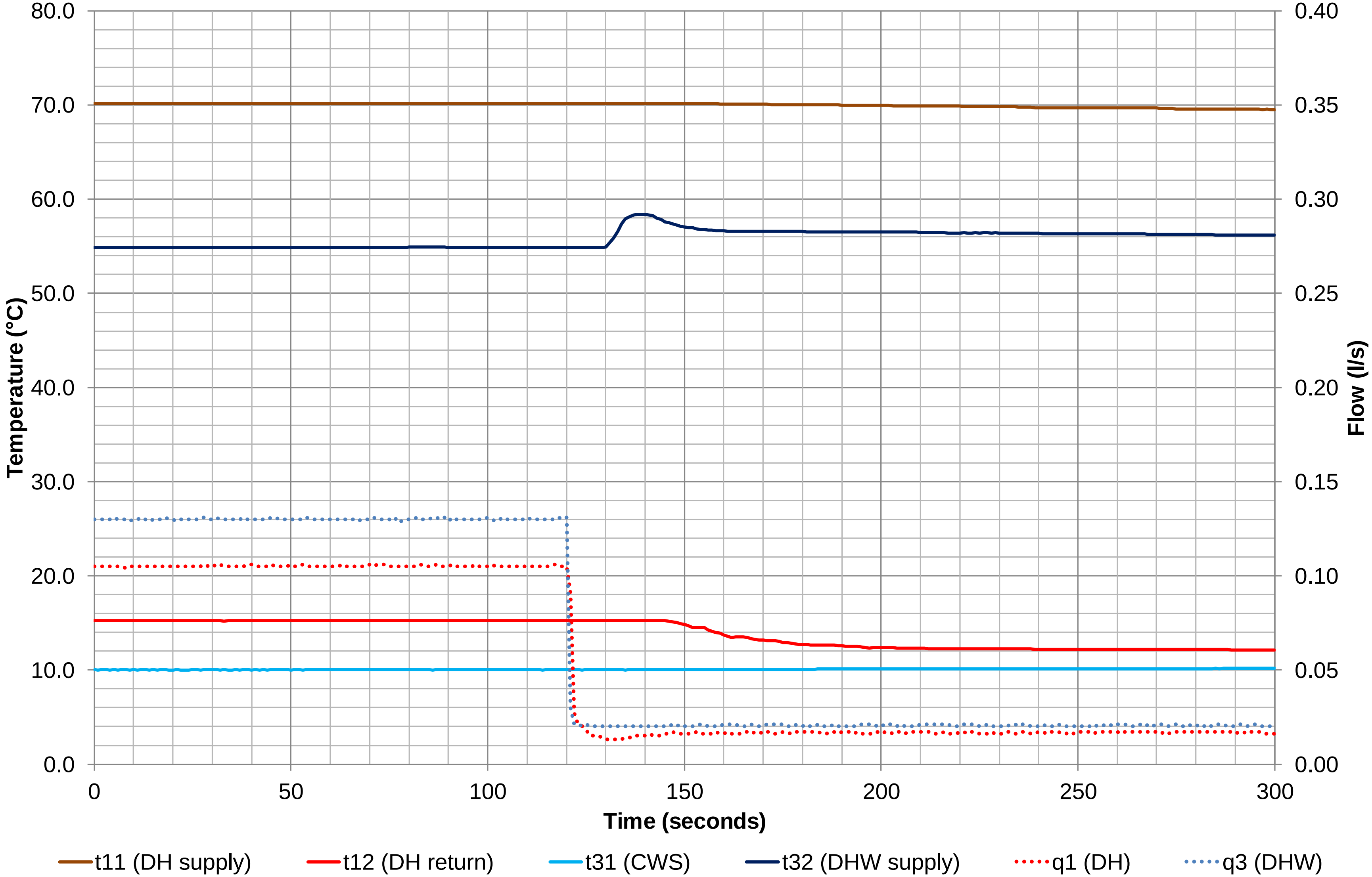


**Figure 13 Results for test 3b: Low flow DHW test – DH 60°C supply**

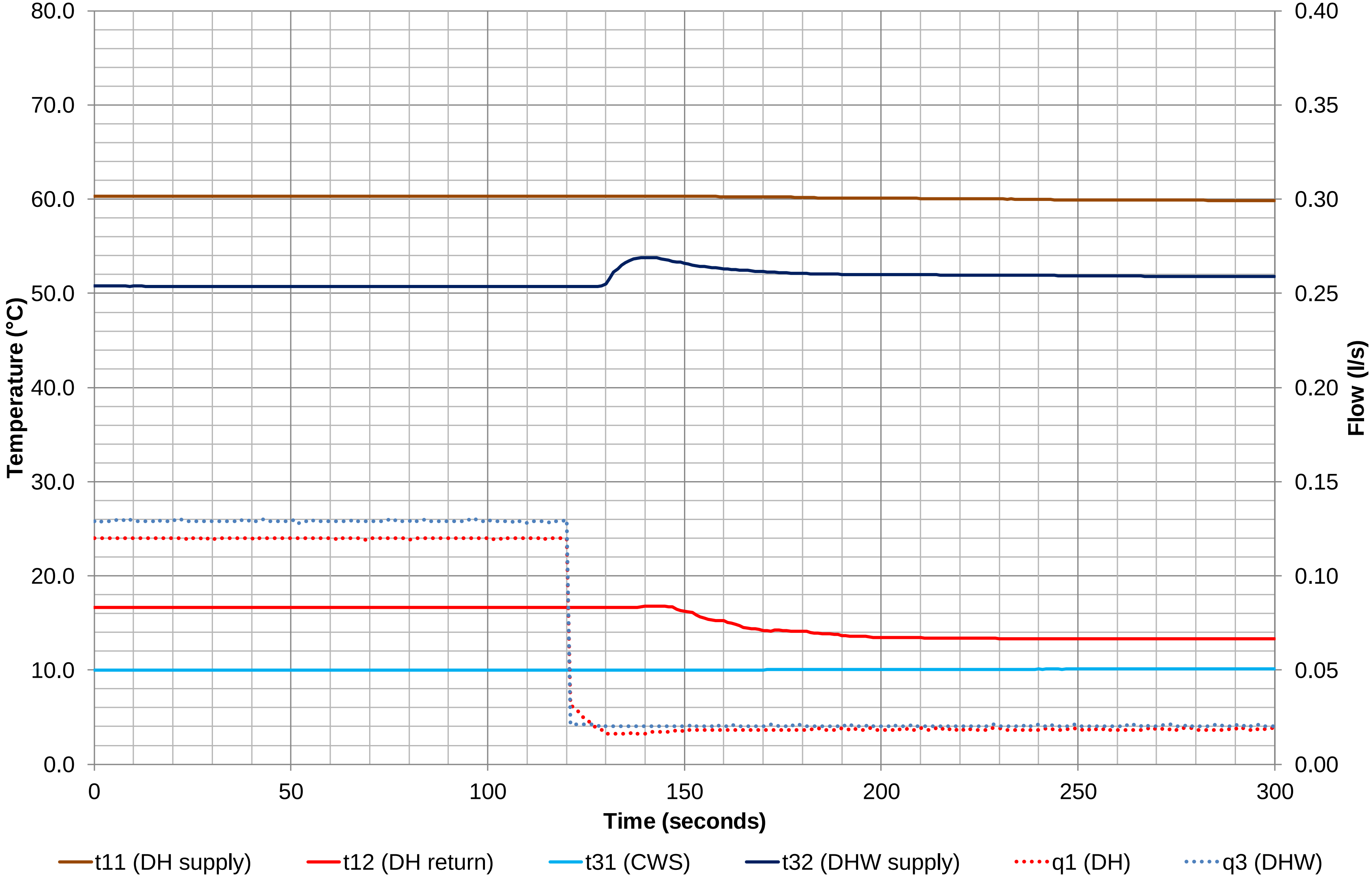


**Figure 14 Results for test 4a: Keep warm test – DH 70°C supply**

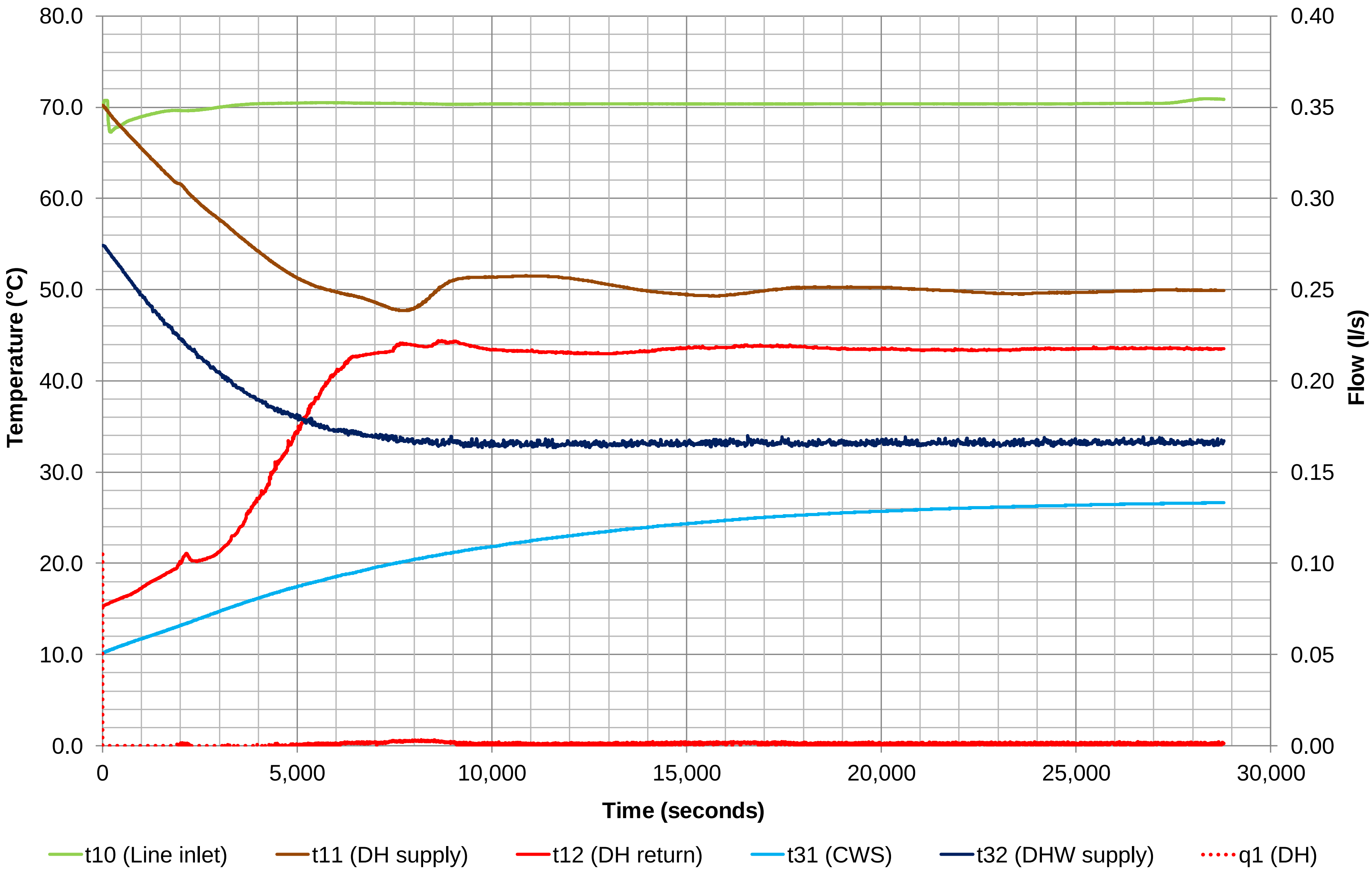


**Figure 15 Results for test 4b: Keep warm test – DH 60°C supply**

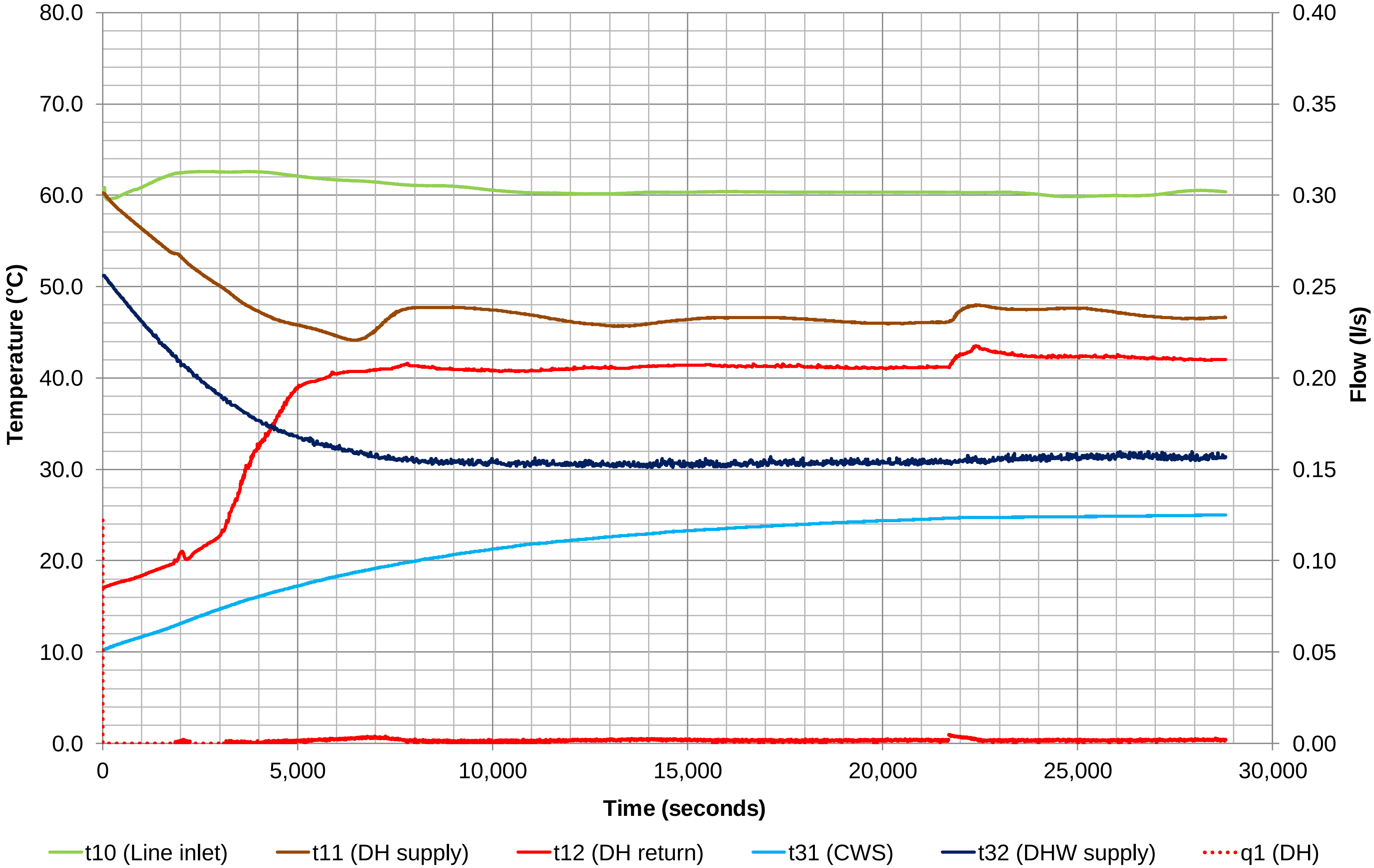


**Figure 16 Results for test 5a: DHW response time – DH 70°C supply**

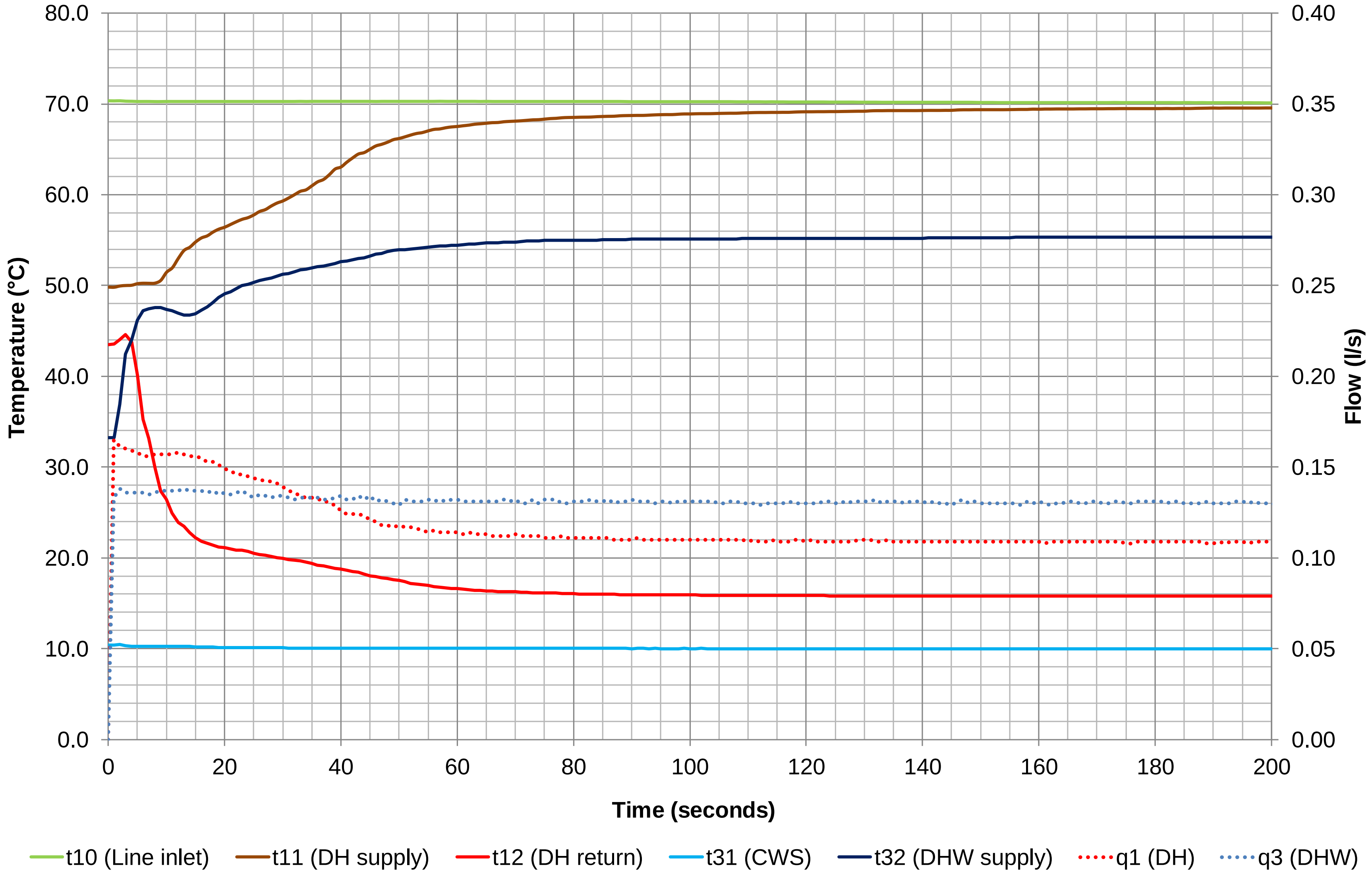
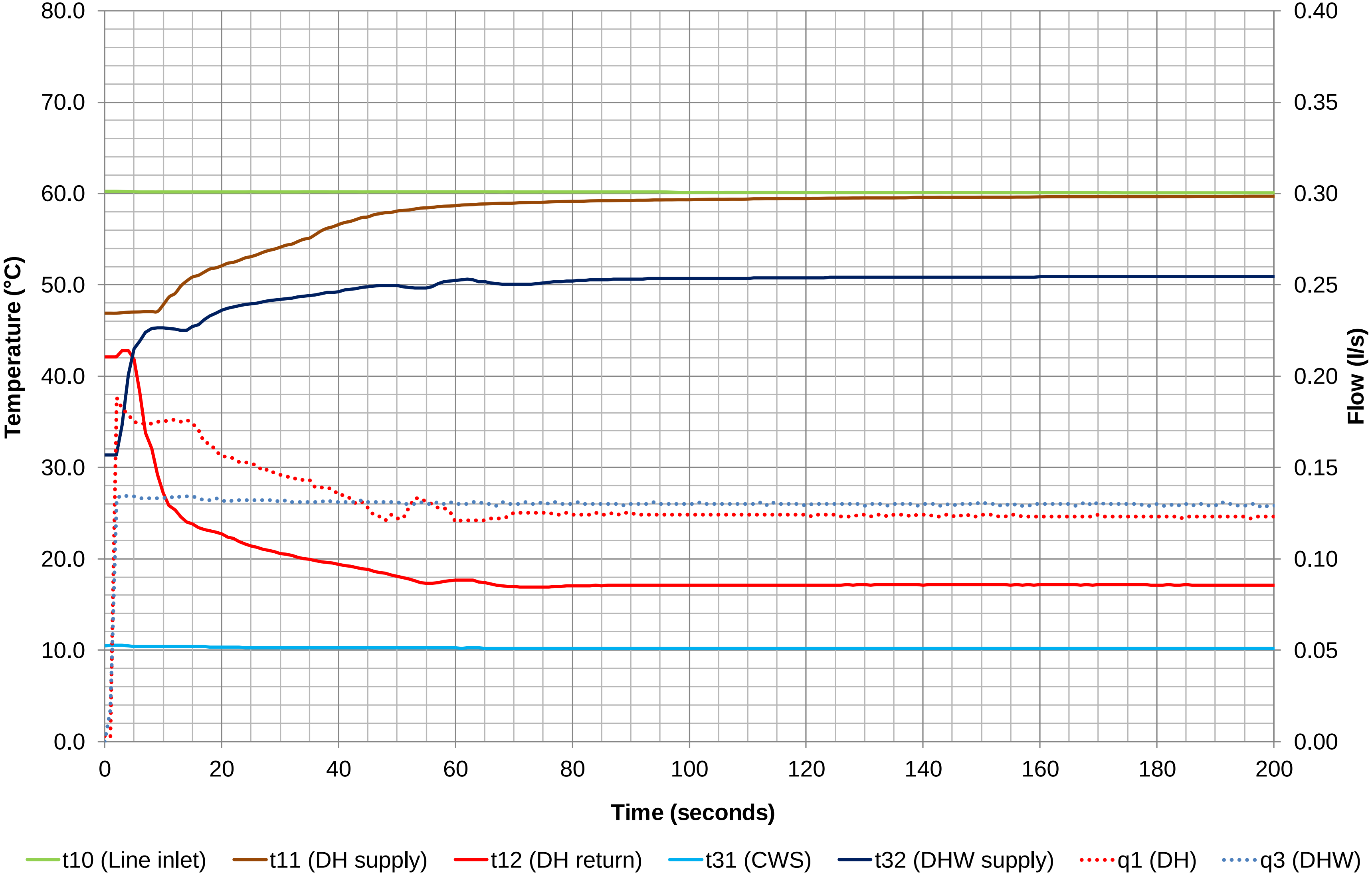


**Figure 17 Results for test 5b: DHW response time – DH 60°C supply**



# APPENDIX B: VWART CALCULATIONS

# High Temperature VWART Calculations

**High Temperature VWART Calculation for SAV Systems.**
Primary flow temperature = 70°C, DHW set point = 55°C, Space heating temperatures = 40°C/60°C
Test carried out by BSRIA Ltd. in June/July 2022, Test Reference 104363/1
Manufacturer: Danfoss – Gemina Termix; Model: VVX-IV 5 RAD; Serial number: K2953653-1; Year of manufacture: 2022
VWART calculation prepared by Colin Judd of BSRIA Ltd. on 13 July 2022

| | VWART (°C) | Volume ($m^3$) |
|---|---|---|
| **DHW** | 16 | 23.4 |
| **Keep Warm** | 43 | 30.0 |
| **Space Heating** | 40 | 44.0 |

| | VWART with keep warm active | |
|---|---|---|
| **Period** | VWART (°C) | % Time |
| **No Heating** | 31 | 93% |
| **Heating** | 39 | 7% |
| **Overall** | 32 | |

| | DHW draw test results | | | Post DHW draw (60 Seconds) | |
|---|---|---|---|---|---|
| | Power (W) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| Low | 11360 | 0.182 | 15.5 | 0.000 | 15.5 |
| Medium | 19121 | 0.304 | 15.5 | 0.000 | 0.0 |
| High | 24139 | 0.383 | 15.6 | 0.000 | 0.0 |

| DHW draw volumes per annum | | |
|---|---|---|
| Energy (kWh) | Time (Hours) | Volume ($m^3$) |
| 729 | 64.17 | 11.651 |
| 297 | 15.53 | 4.723 |
| 444 | 18.39 | 7.045 |

| Post DHW draw volumes per annum | | |
|---|---|---|
| Events | Avg duration (Seconds) | Volume ($m^3$) |
| 10000 | 30 | 0.005 |
| 660 | 75 | 0.000 |
| 300 | 145 | 0.000 |

| Keep warm test results | |
|---|---|
| Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| 0.0037 | 43.3 |

| Keep Warm volumes per annum | |
|---|---|
| Time (Hours) | Volume ($m^3$) |
| 8032 | 29.996 |

| | Space Heating Test Results | | |
|---|---|---|---|
| | Power (W) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| 1kW | 998 | 0.031 | 39.6 |
| 2kW | 2003 | 0.061 | 40.1 |
| 4kW | 4080 | 0.122 | 40.4 |

| Space Heating volumes per annum | | |
|---|---|---|
| Energy (kWh) | Time (Hours) | Volume ($m^3$) |
| 98 | 98.16 | 3.043 |
| 787 | 392.85 | 24.043 |
| 565 | 138.47 | 16.939 |

# Low Temperature VWART Calculations

**Low Temperature VWART Calculation for SAV Systems.**
Primary flow temperature = 60°C, DHW set point = 50°C, Space heating temperatures = 35°C/45°C
Test carried out by BSRIA Ltd. in June/July 2022, Test Reference 104363/1
Manufacturer: Danfoss – Gemina Termix; Model: VVX-IV 5 RAD; Serial number: K2953653-1; Year of manufacture: 2022
VWART calculation prepared by Colin Judd of BSRIA Ltd. on 13 July 2022

| | VWART (°C) | Volume ($m^3$) |
|---|---|---|
| **DHW** | 17 | 29.5 |
| **Keep Warm** | 41 | 44.0 |
| **Space Heating** | 35 | 52.3 |

| | VWART with keep warm active | |
|---|---|---|
| **Period** | VWART (°C) | % Time |
| **No Heating** | 31 | 93% |
| **Heating** | 35 | 7% |
| **Overall** | 32 | |

| | DHW draw test results | | | Post DHW draw (60 Seconds) | |
|---|---|---|---|---|---|
| | Power (W) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| Low | 10296 | 0.209 | 16.8 | 0.000 | 0.0 |
| Medium | 17181 | 0.341 | 16.7 | 0.000 | 0.0 |
| High | 21768 | 0.433 | 16.7 | 0.000 | 0.0 |

| DHW draw volumes per annum | | | Post DHW draw volumes per annum | | |
|---|---|---|---|---|---|
| Energy (kWh) | Time (Hours) | Volume ($m^3$) | Events | Avg duration (Seconds) | Volume ($m^3$) |
| 729 | 70.80 | 14.762 | 10000 | 30 | 0.000 |
| 297 | 17.29 | 5.890 | 660 | 75 | 0.000 |
| 444 | 20.40 | 8.830 | 300 | 145 | 0.000 |

| Keep warm test results | |
|---|---|
| Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| 0.0055 | 41.2 |

| Keep Warm volumes per annum | |
|---|---|
| Time (Hours) | Volume ($m^3$) |
| 8042 | 43.967 |

| | Space Heating Test Results | | |
|---|---|---|---|
| | Power (W) | Primary Flow ($m^3$/hr) | Return Temp (VWART) (°C) |
| 1kW | 1037 | 0.039 | 34.8 |
| 2kW | 2112 | 0.076 | 34.9 |
| 4kW | 3970 | 0.144 | 35.7 |

| Space Heating volumes per annum | | |
|---|---|---|
| Energy (kWh) | Time (Hours) | Volume ($m^3$) |
| 98 | 94.47 | 3.654 |
| 787 | 372.55 | 28.192 |
| 565 | 142.31 | 20.484 |

# APPENDIX C: CERTIFICATE OF CONFORMITY SUPPLIED BY THE CLIENT

Danfoss

**Termix VVX-IV - 7 Series DS Fully insulated**

## Declaration of conformity

ENGINEERING TOMORROW
Danfoss

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# UK DECLARATION OF CONFORMITY

## Danfoss A/S

**Danfoss District Energy Division**

Declares under our sole responsibility that the:

**Product category:** Small substations

**Type designations:**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Ø18:** | HD | BTD | VMTD mini mix | VX | VVX | One Solar |
| | | BVX | VMTD mix | | | Mixing loop |
| | | | VMTD F mix | | | Measuring Unit |
| **C28:** | CS 28 HD | BV | CS 28 VMTD | CS 28 VX | CS 28 VVX | BL |
| **C32:** | CS 32 HD | BV | CS 32 VMTD | CS 32 VX | CS 32 VVX | |
| **C40:** | | BV | CS 40 VMTD | CS 40 VX | CS 40 VVX | |

Covered by this declaration is in conformity with the following directive(s), regulation(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

**Supply of Machinery (Safety) Regulations 2008**

**BS EN ISO 12100:2011**
Safety of machinery – General principles for design – Risk assessment and risk reduction

**BS EN 60204-1:2018**
Safety of machinery – Electrical equipment of machines – Part 1: General requirements

**The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (as amended)**

**BS EN IEC 63000:2018**
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

**Electromagnetic Compatibility Regulations 2016**

**BS EN 61000-6-1:2007**
Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity residential, commercial and light-industrial environments

**BS EN 61000-6-2:2005**
Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments

**BS EN 61000-6-3:2007 + A1:2011**
Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments

| | | | |
|---|---|---|---|
| **Date:** 2022.01.13<br>**Place of issue:** DK-7451 Sunds | **Issued by:**<br>Claus G. Mortensen<br>**Signature:**<br>**Name:** Claus G. Mortensen<br>**Title:** Quality Manager | **Date:** 2022.01.13<br>**Place of issue:** DK-7451 Sunds | **Approved by:**<br>Karina Friis Skov<br>**Signature:**<br>**Name:** Karina Friis Skov<br>**Title:** Director, Engineering |

Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

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