BRITISH STANDARD

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50350:2004

Charging control systems for household electric room heating of the storage type — Methods for measuring performance

The European Standard EN 50350:2004 has the status of a British Standard

ICS 97.100.10

National foreword

This British Standard is the official English language version of EN 50350:2004.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electric appliances, to Subcommittee CPL/59/3, Heating appliances (Room and water), which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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English version

Charging control systems for household electric room heating of the storage type – Methods for measuring performance

Systèmes de commande de charge des appareils de chauffage à accumulation à usage domestique - Méthodes de mesure de l'aptitude à la fonction

Aufladesteuerungen für elektrische Speicherheizungen für den Hausgebrauch - Verfahren zur Messung der Gebrauchseigenschaften

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the CENELEC BTWG 70-1, Charging controls for storage heating appliances.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50350 on 2004-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2005-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2007-04-01

Contents

1 Scope

This standard applies to charging control systems for household electric room heating (systems) of the storage type with internal energy source (resistors).

The object of this standard is to list and define, for the information of the users, the main performance characteristics of the charging control systems and to describe standard methods for verifying these characteristics and to improve quality. This standard does not deal with safety requirements.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60531 Household electric thermal storage room heaters – Methods for measuring performance (IEC 60531, modified)

3 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
charging control system
system which consists of control and adjustment elements for the charging of storage heating units (e.g. storage heaters)

A charging control system regulates the heat content of a storage heating unit within an allowed charging period as a function of the climatic conditions. The assembly of all the components required to carry out this task is called charging control system.

The individual components can have one or several functions and can consist of several elements

3.2
outside sensor
component which measures the outside climatic conditions (e.g. temperature) and transmits the measured value as an information to other components of the charging control

3.3
central control unit
component which transmits command settings to other components as a function of information received from sensors and as a function of the daily charge program

3.4
timer
component which determines the start time and end time of a charge within an allowed charge period

3.5
group control unit
component which amplifies the command setting of the central controller and facilitates the matching of individual heat requirements

3.6
charge controller
the charge controller of a storage heating unit (e.g. storage heater) is a component which controls the charge as a function of the heat content and the command setting of the central controller or the group controller. This enables each storage heating unit to be matched to the heat requirements of the individual rooms

3.7
characteristic curve adjuster
adjustable element of a component of a charging control system which enables to modify the characteristic curve of an output signal

3.7.1
accessible to the service engineer only
a characteristic curve adjuster is considered to be accessible only to the service engineer if the characteristic curve adjuster requires tools for setting

3.7.2
accessible to the user
a characteristic curve adjuster is considered to be accessible to the user if the characteristic curve adjuster can be freely set and the setting read on a scale in case of normal installation conditions of the charging control system

3.8
charge period
period during which the storage heater is enabled to convert electrical power into heat in order to store it in the accumulating core

3.8.1
supply charge period
longest period (in hours) of uninterrupted electrical supply to the heater

NOTE The length of this period is set and shall be published by the utility.

3.8.2
additional supply charge period
any period of uninterrupted electrical supply to the heater, additional to the supply charge period

NOTE The length and sequence of these periods are set and shall be published by the utility.

3.8.3
supplementary charge period (T_{zf} – in hours)
sum of additional supply charge periods in a daily charge program

3.8.4
daily charge program
sequence of charge periods (supply and additional supply periods) over a 24 h cycle, beginning with the supply charge period

3.9
load characteristic
property of a charging control system which determines the switching-on behaviour of storage heating units within the daily charge program. The changeover from the main load characteristic to the supplementary load characteristic occurs at time T_4

3.9.1
forward charging
takes place when the charge switches on at the start of the supply charge period and instant of switching-off is set by the climatic conditions and the heat content of the storage heating units

3.9.2
backward charging
takes place when instant of switching the charge on is set by the climatic conditions and by the heat content of the storage heating units and instant of switching-off is given by the end of the supply charge period

3.9.3
spread charging
modified form of backward charging. The instant of switching-on and switching-off are set by the climatic conditions, the heat content of the storage heating units and a time function

4 Classification

4.1 According to the time function

Central control unit with timer.

Central control unit without timers.

4.2 According to the location of the charge controller

Located in the storage heater.

Located outside the storage heater.

4.3 According to the specification of variables

Type A: AC voltage - power based signal.

Type B: DC voltage.

Type C: AC voltage - digitised signal.

Type D: AC voltage - binary signal.

5 List of measurements

5.1 Symbols, units and abbreviations used

List of symbols, units and abbreviations for the charging control system for storage heaters

Symbol	Unit	Designation
E1	--	Characteristic curve adjuster for full charging
E2	--	Characteristic curve adjuster for start of charge
E3	--	Characteristic curve adjuster for elapsed time at which the optimal charge is theoretically reached
E4	--	Characteristic curve adjuster for the minimum charge base
E5	--	Global characteristic curve adjuster for a group control unit
E6	--	Characteristic curve adjuster for maximum heat content limiter
E7	--	Global characteristic curve adjuster for charging within the main load characteristic (floor storage heating)
E8	--	Global characteristic curve adjuster for charging within the supplementary load characteristic (floor storage heating)
E10	--	Characteristic curve adjuster for the supplementary load characteristic
E11	--	Length of the period during which, if an interruption of the supply charge period appears, the timer of charge controller is stopped up to the end of this interruption
E12	--	End point of the main load characteristic i.e. switching over point to the supplementary charging characteristic
E13	--	Length of the cycle during which the clock of the charge control system is running
E14	--	Characteristic curve adjuster for the total charging period limiter (floor storage heating)
E15	--	Characteristic curve adjuster for the level of charge allowed by E2
E16	--	Additional curve adjuster for restriction of supplementary load characteristic depending on the adjustment of E1
X_{E1}	°C	Setting point for E1
X_{E2}	°C	Setting point for E2
X_{E3}	h	Setting point for E3
X_{E4}	%	Setting point for E4
X_{E5}	%	Setting point for E5
X_{E6}	%	Setting point for E6
X_{E7}	%	Setting point for E7
X_{E8}	%	Setting point for E8
X_{E10}	%	Setting point for E10
X_{E11}	h	Setting point for E11
X_{E12}	h	Setting point for E12
X_{E13}	h	Setting point for E13
X_{E14}	h	Setting point for E14 (floor storage heating)
X_{E15}	%	Setting point for E15
X_{E16}	0/1	Setting point for E16
T_f	h	Length of supply charge period

Symbol	Unit	Designation
T_{zf}	h	Length of supplementary charge period
T	h	Elapsed time since the beginning of the last supply charge (running time)
T_0	h	Starting point of the load-characteristic
T_1	h	Length of the period during which, if an interruption of the supply charge period appears, the timer of charge controller is stopped up to the end of this interruption
T_3	h	Elapsed time at which the optimal charge is theoretically reached
T_4	h	End point of the main load characteristic i.e. switching over point to the supplementary charging characteristic
T_5	h	The end of the cycle during which the clock of the charge control system is running
T_{off}	s	Length of period switched-off
T_{on}	s	Length of period switched-on
n		Number of switched-on supply periods within T (control cycle)
n_{max}		Maximum number of supply periods within T (control cycle)
U	V	Supply voltage
I	A	Value of electric current
P_N	kW	Rated input of storage heating unit
O_a	°C	Outside temperature
O_u	°C	Ambient temperature
X_{eF}	°C	Input value of outside sensor
X_{aF}	*	Output variable of outside sensor
X_{uF}	*	Output variable of ambient temperature sensor
X_{e1}	*	Input variable of central control unit for outside condition
X_{e2}	*	Input variable for running control of the timer in accordance with the tariff-situation
X_{e3}	%	Input variable of group control unit
X_{e4}	%	Input variable of charge controller
X_{e5}	%	Input variable of heat content measurement of an appliance
X_{a1}	%	Output variable of central control unit
X_{a3}	%	Output variable of group control unit
X_{a4}	--	Binary output control signal to switch the charge
X_{aW}	%	Output variable of heat content measurement of an appliance
X_{eW}	%	Instantaneous allowed heat content calculated by the central control unit (set charging rate)
U_{a1}	V	Output voltage of central control unit
N_{a1}	--	Number of connectable charge controllers
N_{a3}	--	Number of connectable group control units
Z_{a1}	kΩ	Output impedance of central control unit
Z_{a3}	kΩ	Output impedance of group control unit
Z_{e3}	kΩ	Input impedance of group control unit
Z_{e4}	kΩ	Input impedance of charge controller
* Shall be defined by the manufacturer.		

5.2 List of test and measurements

- X_{a1} (test has to be made in accordance to Clause 9).
- Performance of the charging control system (test has to be made in accordance to Clause 12).
- Performance of type D (test has to be made in accordance to Clause 13).

6 General conditions for measurements

6.1 Power supply

If the central control unit requires a main power supply, this shall perform normally for a supply voltage of AC 230 V + 10 % - 15 % at 50 Hz.

During tests the supply voltage has to be 230 V AC ± 1 %.

6.2 Configuration

The configuration of the charging control system shall be in accordance with this given by the manufacturer.

Examples showing the combined action of components of different charging control systems are given in Figure 1a and Figure 1b.

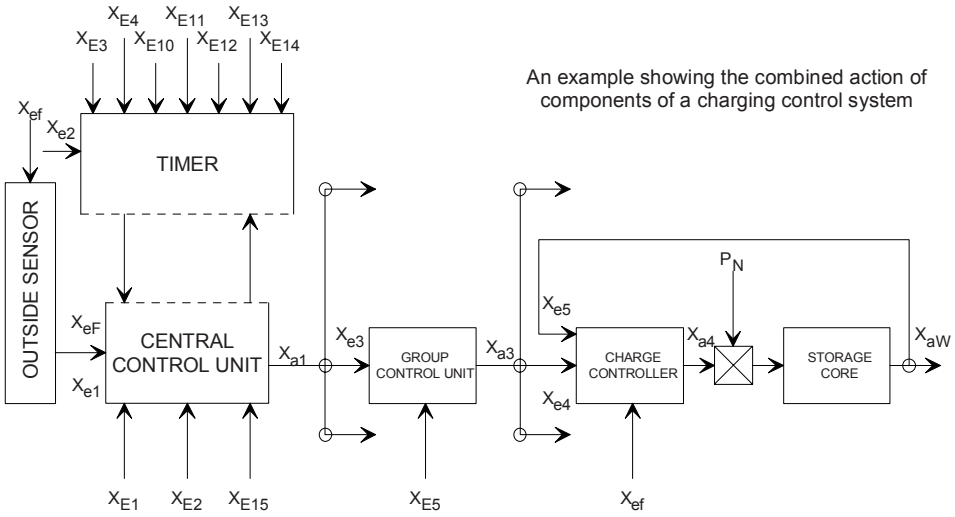


Figure 1a – Combined action of components of a charging control system with an outside sensor

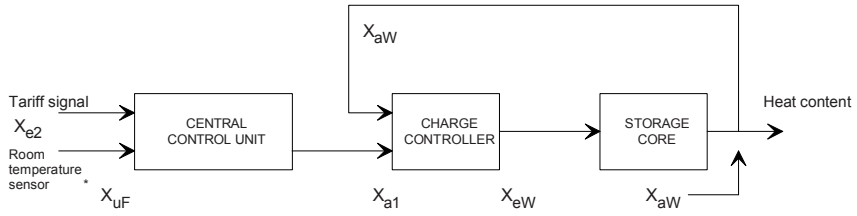


Figure 1b – Combined action of components of a charging control system without an outside sensor

6.3 Mounting

Unless otherwise specified, the mounting, wiring and configuration of the charging control system shall be in accordance with the manufacturer instruction.

As far as it is planned for installation into an electric distribution board, the central control unit shall be pluggable into a clearly allocated and firmly installable socket. These units shall be suitable for assembly on rails.

7 Marking and instruction

To achieve the tests, the charging control system manufacturer shall provide to the test laboratory, the following information : adjustments of the charging control system parameters for each test, needed inputs (core temperature, ambient temperature, tariff signal, …), characteristic curves of the different probes.

7.1 Information to be given by the manufacturer

The manufacturer shall provide information for

- buying and sizing,
- installation and servicing,
- use and cleaning.

Details shall be available on the position, accessibility and effect of the settings adjusters and wiring possibilities. The display of operational conditions shall be explained.

The information to be given by the manufacturer is listed in Annex A.

7.2 Markings

For all characteristic curve adjusters and terminal markings the marking shall be

- either in accordance with the symbols listed under 5.1 or 7.5,
- or a symbol not listed under 5.1. In this case, the manufacturer shall give the corresponding standard symbol in the documentation.

As an adjusting device is allocated to a characteristic curve adjuster, it shall be marked with the corresponding setting range with numerical values and the associated unit.

The type designation shall be marked on the front panel of each unit.

7.3 Construction and dimensions

The manufacturer shall declare the dimensions of each component of the charging control system.

7.4 Displaying on the appliance

For types A, B and C, the following information shall be displayed on the appliance with timer, if a digital display is available:

- values of the setting point of the standardised adjusters;
- set charging rate;
- running time;
- sensor interrupting;
- X_{a1} – signal;
- time signal is running;
- sensor short-circuit;
- outside temperature;
- charge.

7.5 Functional requirements

See Table 1.

Table 1 – Functional requirements for terminals

Marking	Terminal	Function	Functional description	Explanation
LF	Terminal	F	Supply charge period	Usually principal charge of load during the supply charge period
LZ	Terminal	F	Additional supply charge period	Additional supply charge period during the course of the day
LL	Terminal	F	Start of timer	Only starting signal of characteristic curve (Usually separation from ”LF” must be effected)
VR		F	Switch-off time influence	With the simultaneous activation of LF and LZ or available terminal VR, the time response (T_0 … T_5) is put entirely out of action.
KU	Terminal	F	Second characteristic	When KU is driven, the second set characteristic curve becomes effective.
L/N	Terminal		Auxiliary power	Supply voltage 230 V + 10 - 15 % 50 Hz

8 Specification of variables for the outside sensor

The input variable X_{eF} is the temperature at the measuring point.

For types A, B and C, the output variable X_{aF} shall be in accordance with Table 2 below.

For type D, if an outside sensor is used, the output variable X_{aF} shall be in accordance with a table given by the manufacturer. Within the temperature range -10 °C to +18 °C the accuracy shall be $\leq \pm 1$ °C. If the manufacturer uses a resistive sensor, it is recommended to follow Table 2.

Table 2 – Ohmic values for a resistive sensor

Temp. value °C	Ohmic value Ω	Temp. value °C	Ohmic value Ω
-10	8 942	+5	4 527
-9	8 529	+6	4 336
-8	8 137	+7	4 153
-7	7 764	+8	3 980
-6	7 412	+9	3 814
-5	7 077	+10	3 657
-4	6 759	+11	3 507
-3	6 457	+12	3 364
-2	6 171	+13	3 227
-1	5 900	+14	3 098
±0	5 641	+15	2 974
+1	5 396	+16	2 854
+2	5 161	+17	2 742
+3	4 940	+18	2 634
+4	4 728		

9 Central control unit (C.C.U.)

The output variable X_{a1} is to be measured.

9.1 Type A – AC voltage - power measurement

The output variable X_{a1} is the ratio of the number of switch-on supply periods (n) to the maximum number of supply periods in a control cycle (n_{max}).

The maximum number n_{max} shall be 500.

The signal shall be zero-volt switched.

The relationship between the output variable X_{a1} and the calculated allowed heat content X_{eW} is:

$$X_{a1} = 80\ \% - (0{,}78 \times X_{eW})$$

or

$$X_{eW} = (80\ \% - X_{a1}) / 0{,}78$$

When $X_{a1} = 0$ ⇨ X_{eW} is maximum.

The output variable shall be compensated for mains supply variations.

9.2 Type B – DC voltage

The output voltage X_{a1} shall be a DC voltage U_{a1} of max. DC 10 V.

The relationship between U_{a1} and X_{a1} is linear and given by

$$\frac{U_{a1} - U_{a1}(O)}{U_{a1}(100) - U_{a1max}(O)} \times 78$$

$X_{a1} = (U_{a1}/U_{a1max}) \times 100$ in %.

The relationship between the output variable X_{a1} and the calculated allowed heat content X_{eW} is:

$$X_{a1} = 80\ \% - (0{,}78\ X_{eW})$$

or

$$X_{eW} = (80\ \% - X_{a1}) / 0{,}78$$

NOTE An output signal < 2 % is not generated under normal operation. The output of such a signal usually indicates an error.

9.3 Type C – AC voltage - digitised signal

The output variable X_{a1} is the ratio of the number of switch-on (full-wave) supply periods (n) to the maximum number of supply period in a control cycle (n_{max}).

The maximum number n_{max} shall be 500.

The signal shall be zero-volt switched.

The relationship between the output variable X_{a1} and the calculated allowed heat content X_{eW} is:

$$X_{a1} = 80\ \% - (0{,}78\ X_{eW})$$

or

$X_{eW} = 0$ for $X_{a1} < 2\ \%$

$= (80\ \% - X_{a1}) / 0{,}78$ for $2\ \% < X_{a1} < 100\ \%$

When $X_{a1} = 0$ ⇨ $X_{eW} = 0$

NOTE A non-zero output signal < 2 % is not generated under normal operation. The output of such a signal variable usually indicates an error.

9.4 Type D - AC voltage - binary signal

If X_{a1} is a binary - AC Voltage, the central control unit orders the charge controller to charge the storage core.

When the AC Voltage signal disappears, no more charge is allowed.

9.5 Characteristic curve of calculated allowed heat content X_{eW}

The manufacturer shall give the optimal settings to be made in function of the different daily charge periods and the requirements of the local utilities. In most of the countries, local utilities require forward, backward or spread charging.

This characteristic curve shall not be given for central control units of type D. But for this type, the manufacturer shall describe the main rules of the charge logic.

9.5.1 Without timer

The variable X_{eW} is a linear variable of X_{eF} as shown in Figure 2.

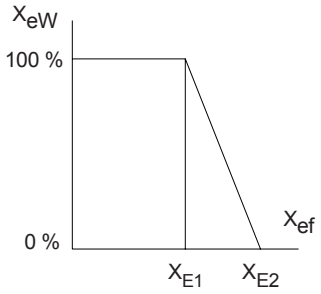


Figure 2 – X_{eW}

9.5.2 With timer

For type A, B and C central controls units, the variable X_{eW} is a function of time and outdoor temperature as given in Figure 3. The requirements for the characteristic curve adjusters are given in Table 4.

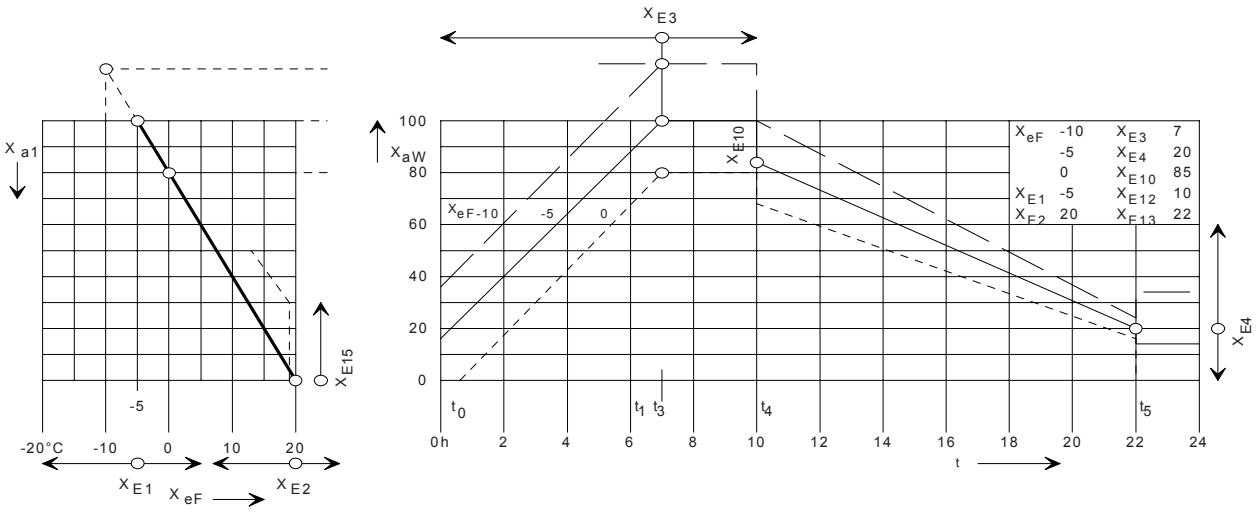


Figure 3 – Instantaneous allowed heat content X_{eW} as a function of the outside sensor's input variable X_{eF} and the running time T

Table 3 – Charging rate X_{aW} as a function of T, weather value X_{eF} and setting variables

Running time T	Outside temperature X_{eF}	Charging rate	Conditions	Time function on/off
$T_0 < T < T_3$	$X_{eF} < X_{E2}$	$X_{aW} = X_{aW}{}^* - 85\ \%\ \ 1 - \frac{T}{T_3}$	Without VR activation	on
$T_3 < T < T_4$	$X_{eF} < X_{E1}$	$X_{aW} = 100$	Without VR activation	on
$T_3 < T < T_4$	$X_{eF} < X_{E2}$	$X_{aW} = X_{aW}{}^*$		
$T_4 < T < T_5$	$X_{eF} < X_{E2}$	$X_{aW}\ \frac{X_{E10}}{100} \times X_{aW}{}^* \times \left[1 - \left(1 - \frac{X_{E4}}{100}\right)\ \frac{T - T_4}{T_5 - T_4}\right]$	Without VR activation	on
$T_5 < T < T_0$	$X_{eF} < X_{E2}$	$X_{aW} = X_{aW}{}^* - 85\ \%$	Without VR activation	on
T	$X_{eF} < X_{E1}$	$X_{aW} = 100\ \%$	With VR activation	off
T	$X_{eF} < X_{E2}$	$X_{aW} = X_{aW}{}^*$	With VR activation	off
T	$X_{eF} > X_{E2}$	$X_{aW} = 0\ \%$		

In this case, the weather-dependent value $X_{aW}{}^*$ is applicable:

$$X_{aW}{}^* = \left[\frac{100 - X_{E15}}{X_{E2} - X_{E1}} \times (X_{e2} - X_{eF})\right] + X_{E15}$$

Table 4 – Requirements of the characteristic curve adjusters

Characteristic adjuster	Marking	Function	Setting range at least	Resolution [a] of setting range/display	Accessibility [b] for service engineer	Accessibility for user
E1	Full charge	Setting of temperature values X_{eF} for which full charge is realised	-20 °C < X_{E1} < +5 °C	≤ 1 K	X	
E2	Start of charge	No charge is realised	+7 °C < X_{E2} ≤ 22 °C	≤ 1 K		X
E3	Main charge point	Influence of temporary course of charging in the charge period, adjustment of T_3	H < X_{E3} (= T_3) < 10 h	≤ 1 h	X	
E4	Min. charge base	Setting of charge base at the time T_5	0 … 60 %	≤ 5 %	X	
E10	Additional supply charge	Setting of start time of characteristic additional supply charge at T_4	100 … 0 %	≤ 5 %		X
E11	Lock	End of operational control T_1	4 … 6 h	--	X	
E12	Daily change-over	Temporary starting point T_4	8 … 10 h	--	X	
E13	Period of circulation	End point T_0	14 … 22 h	--	X	
E14 [c]	LF monitoring	Setting of total period LF + LZ within T (underfloor heating)	8 … 16 h	--	X	
E15	*Charge starting socket*	E2 transfer to a charging rate of at least 0 … 30 % with X_{a1} < 80 %	0 … 50 %	≤ 5 %	X	
E16	*Additional supply restriction*	Additional supply restriction, if measured outdoor temperature is higher than set by E1	0/1	--	X	
T	Running time	Synchronisation of timer with the centralised control or switch clock program (running hours)	0 < T < T_0	≤ 1 h		X

a Rising numerical values in a clockwise direction; with constant setting, the resolution must correspond to a scale length of at least 1 mm with the difference between two dividing lines being not more than 5 K or 1 h.

b Controllability via a keyboard or with a screwdriver or coin in the case of analogue input.

c The function “LF monitoring” is only used in the case of underfloor storage heating systems. LF or LZ will be switched off of the set time period is exceeded.

The margins of error for the timer are ± 2 min over 22 h and at the respective switching points.

The requirements of the characteristic curve adjuster do not apply for the central control unit without timer. When using such a unit the resolution of the setting range must be ≤ 3 K.

10 Group control unit (G.C.U.) for types A, B and C

10.1 Input and output variables (see Figure 1)

The input variable X_{e3} of a group control unit is the output variable X_{a1} of a central control unit. The output variable X_{a3} is proportional to X_{eW} with regard to linearity and height.

10.2 Characteristic curve

Input and output variables, as well as the available adjuster X_{E5} if necessary, are related to each other through the following equation:

$$X_{a3} = X_{e3} + X_{E5}$$

with operating limits: $0 < X_{e3} < X_{a1max}$ and $0 < X_{a3} < X_{a1max}$.

If the group control unit has a characteristic curve adjuster E5, the adjuster must at least over the following range:

$$-30\ \% \leq X_{E5} \leq +10\ \%$$

10.3 Input impedance

The input impedance Z_{e3} of the input variable X_{e3} shall be designed such that up to 20 group control units can be operated by a central control unit.

10.4 Absence of interaction

If faults occur in the output circuit of one group control unit, the operation of any other group control unit driven by the same central control unit may not be disturbed.

This requirement is satisfied when, under the fault condition of the test, the sevenfold value of the input current as under normal condition is not exceeded.

11 Charge controller

The charge controller switches the power for charge acceptance of the storage heater as a function of the input variables X_{e4} and X_{e5}.

11.1 Variables

The input variable X_{e4} of the charge controller is the output variable of a central or group control unit. The variable X_{e5} is the input variable of the heat content measurement X_{aW} of the heat storage appliance.

11.2 Specification of variables

Without any digital signal, no charge is allowed.

11.3 Characteristic curve

The following curve is applicable for the charge controller of a thermal storage room heater (see Figure 4):

$X_{e5} \geq X_{E6}$ - 100 % + X_{e4} OFF

$X_{e5} < X_{E6}$ - 100 % + X_{e4} ON

+ Hysteresis

If the charge controller is located in the room heater, the measurement of the characteristic curve of the charge controller shall be done during the test of the appliance, e.g. for room heaters of the storage type according to EN 60531. The characteristic curve adjuster E6, if it is not located in the room heater, shall be accessible. If required, it can be adjusted only by a service engineer.

The measured switching-on and switching-off values may not deviate from the maximum value by more than ± 20 % for type A controllers and ± 10 % for type B and C controllers.

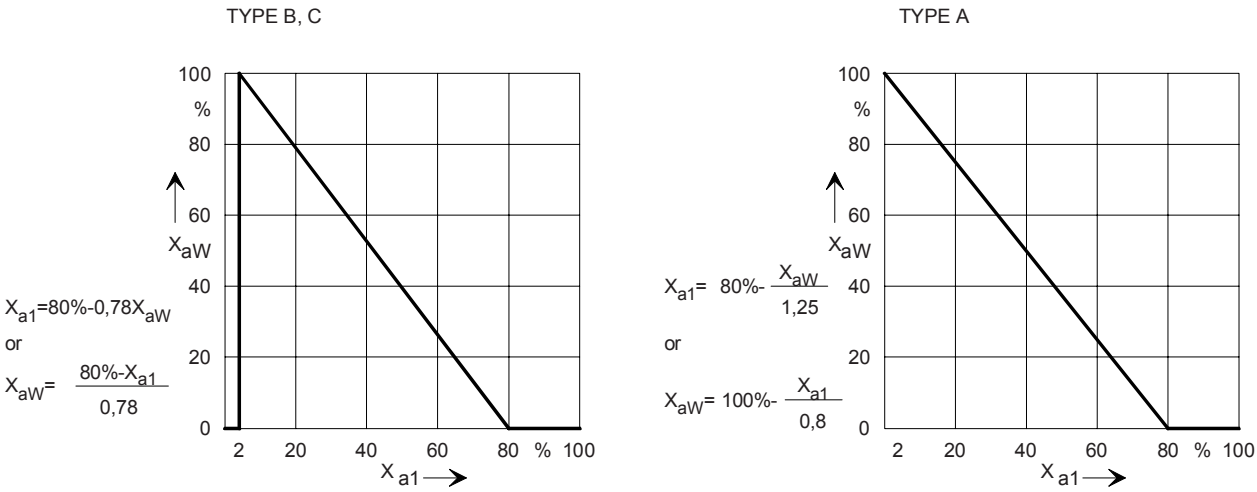


Figure 4 – Characteristic curves of thermal storage room heaters

11.4 Floor storage heating controller

The characteristic curve $X_{e5} = f(X_{e4})$ of a floor storage heating controller is defined within a family of characteristic limited by a polygonal section and a straight line. The polygonal section is marked by the following points:

X_{e4}	100 %	75 %	50 %	25 %	0 %
X_{e5}	100 %	90 %	80 %	55 %	0 %

The straight line runs through the ends of the polygonal line.

Using the characteristic curve adjuster E7, a parallel shift of + 30 % to – 20 % is possible within the main load characteristic. The curve adjuster E8 has the same effect within the supplementary load characteristic (see Figure 5).

In addition, the following limits apply:

$0\ \% \leq X_{e5} \leq 100\ \%$

It is recommended to use the same sensor as the outside sensor. The manufacturer shall supply the measured values of the sensor as a function of the floor temperature for 20 °C ≤ T ≤ 60 °C.

The measured values may deviate from their set values by ± 1,5 K at most.

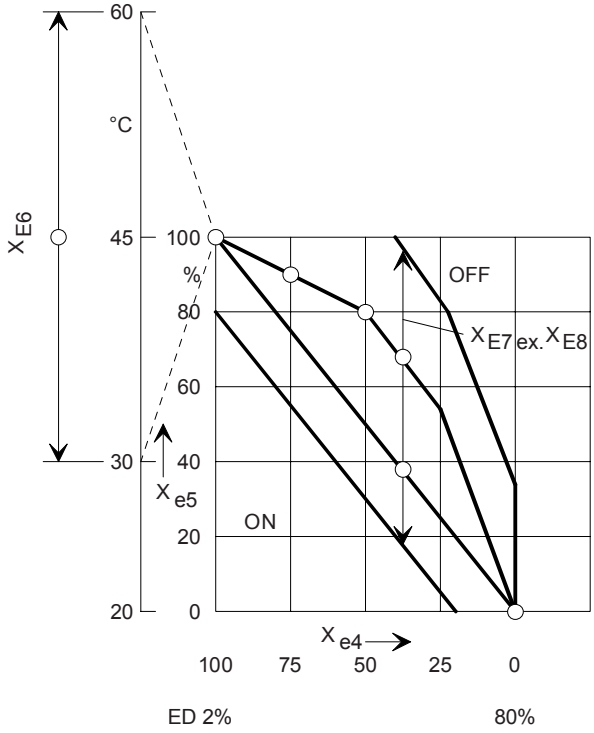


Figure 5 – Set characteristics of charge controller for floor storage heating

11.4.1 Measurements of the performance of the charging control system

11.4.1.1 Configuration

The configuration of the charging control system shall be in accordance with that given by the manufacturer.

11.4.1.2 Dimensions

The dimensions of the group control unit and the central control unit shall be in accordance with those given by the manufacturer.

11.4.1.3 Mounting and wiring

The mounting and wiring of the system shall be in accordance with the manufacturer instructions.

12 Performance of the charging control system of types A, B and C

The charging control system is wired in accordance to the manufacturer instruction and placed under nominal supply conditions.

In accordance to Table 3, the available settings are made.

- E1: -10 °C Full charge setting
- E2: +18 °C Start of charge setting
- E3: 7 h Main charge point setting
- E4: 20 % Minimum charge base setting
- E10: 85 % Additional supply charge setting
- E11: 6 h Lock setting
- E12: 10 h Daily change over setting
- E13: 22 h Period of running
- E14: 10 h LF monitoring setting
- E15: 0 % Charge starting socket
- E16: 0 E1 off setting (no prevention of additional supply charge, if the outdoor temperature is higher than E1)

Display:
If a display is available, the accuracy has to be checked and started.

The outdoor temperature is given as an input X_{eF}, in accordance to manufacturer specification for outdoor sensor, on level –10 °C. The running time is started by simulation of beginning the supply charge period. The output X_{aW} is measured and plotted into a graph over a total period of 24 h.

The measurement is repeated for X_{eF} on level +4 °C.

The measurement is repeated for X_{eF} on level +18 °C.

The three graphs are superposed and compared with the theoretical characteristic graphs given by the manufacturer. The difference between measured and theoretical characteristic graphs for types B and C shall not exceed 5 %, for type A 10 %.

E11 (LOCK) and E16 functions are checked if available.

13 Performance of charging control systems of type D

(under consideration)

13.1 General

The tests regarding type D charging control systems are based upon the ambient temperature measurement of the room. This test measures the performances of the charging control system according to the user's comfort.

The tests of the system would then need a charging control system connected to a storage heater, mounted itself in a climatic test chamber.

In order to simplify the procedure of the test and to reduce the cost, the test means used for the test are based upon a computerised simulation of some elements.

The charging control system shall be connected to the system. The hardware architecture includes the following elements:

a) an input/output interface on which is connected the charging control system;

b) a PC computer allowing the following functions to be achieved :

- simulation of a reference storage heater;
- simulation of a reference room;
- generation of reference climatic conditions;
- generation of a time base.

Simulation of the reference storage heater is based upon model properties of a dynamic storage heater with a 3 kW rated power supply. The model calculates the thermal energy emitted by the heater appliance according the input parameters : duration, power on/off of the resistors, power on/off of the fan.

Simulation of the reference house is based upon a physical model of the biclimatic test chamber as described in EN 60531. The model calculates the air temperature in the centre of the room according to the input parameters : instantaneous thermal energy emitted by the storage heater, outdoor temperature, conditions to the limits (walls temperatures).

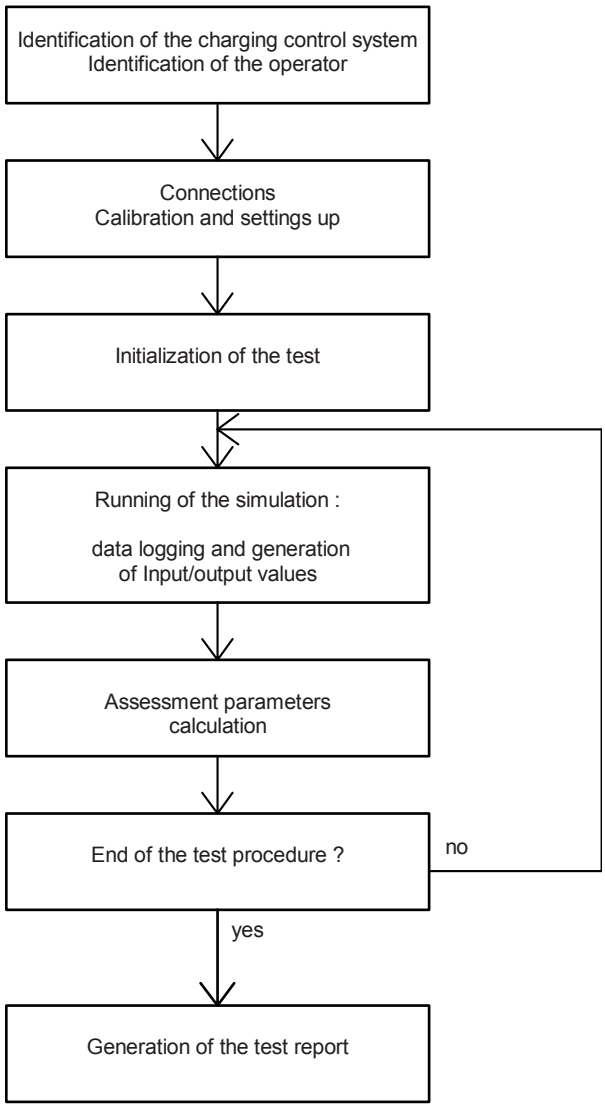
13.2 Test procedure to be followed by the operator having the test in charge

(under consideration)

The operator connects the charging control system input/output according to the information provided by the manufacturer.

The operator carries out connection test and calibration test provided by the simulation means.

The test configuration shall be set by the laboratory which will carry out the tests, in accordance with the daily charge program of the local utility.



The procedure includes 3 tests which represent for the first one, mid season conditions, for the second one, cold season conditions, and for the third one, mid season conditions taking into account the buildings inertia (reheating of the frame).

The simulation is divided into two phases : a parameter stabilisation phase, which duration is a maximum of 4 days, and a criteria count phase. Steady state is considered to be reached when, within a period of two adjacent days, the cumulated charging duration difference is less than 10 %.

In order not to be influenced by the quality of the ambient thermostat, the ambient temperature considered for the validation phase is an averaged temperature. This slipping mean occurs over a period of 10 min.

During the phase of taking into account the criteria, the slipping averaged temperature is recorded. At the end of the test, a global mean averaged temperature is calculated over the last 24 h of the test duration.

The slipping averaged temperature shall be within a range of $\pm$ 0,5 K surrounding the global averaged temperature (see Figure 6).

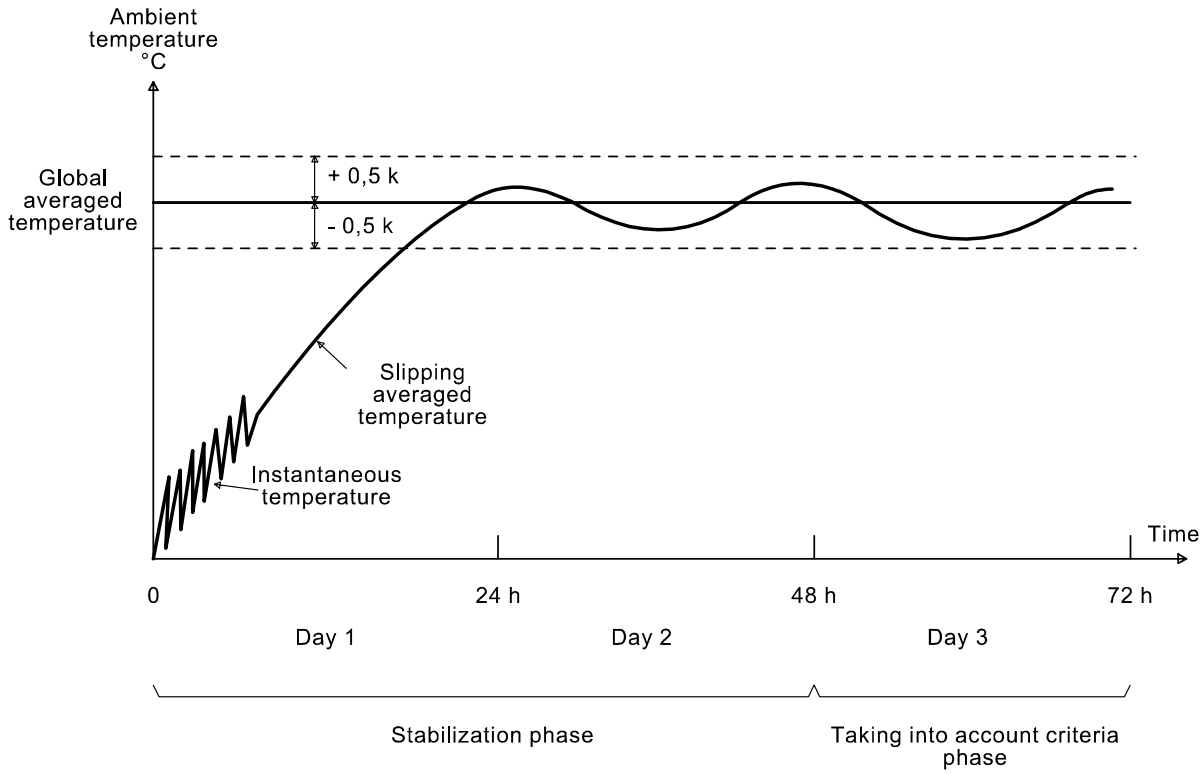


Figure 6 – Temperature curve as a function of time

13.3 Test under mid season condition

The test represents an average mid season day.

The program calculates the mean air temperature in the virtual chamber.

The maximum overheating, difference between the maximum air temperature in the chamber and the average air temperature in the chamber is calculated and shall not exceed 0,5 K.

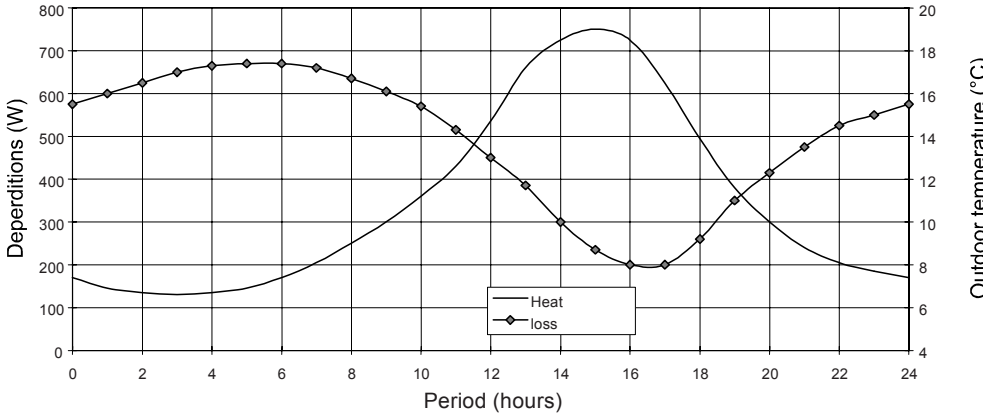
The maximum underheating, difference between the mean air temperature in the chamber and the minimum air temperature in the chamber is checked, so that it does not exceed 0,5 K.

13.4 Test under mid season condition

Definition of a scenario for the outdoor temperature under mid season conditions for a classical house (the heat-loss are known quantities for an indoor temperature of 20 °C).

Hour	0	1	2	3	4	5	6	7	8	9	10	11
Outside temperature °C	7,4	6,9	6,7	6,6	6,7	6,9	7,4	8,1	9	10	11,2	12,6
Heat loss W	575	600	625	650	665	670	670	660	635	605	570	515

Hour	12	13	14	15	16	17	18	19	20	21	22	23
Outside temperature °C	14,7	17,2	18,5	19	18,5	16,5	13,9	11,6	10	8,8	8,1	7,7
Heat loss W	450	385	300	235	200	200	260	350	415	475	525	550

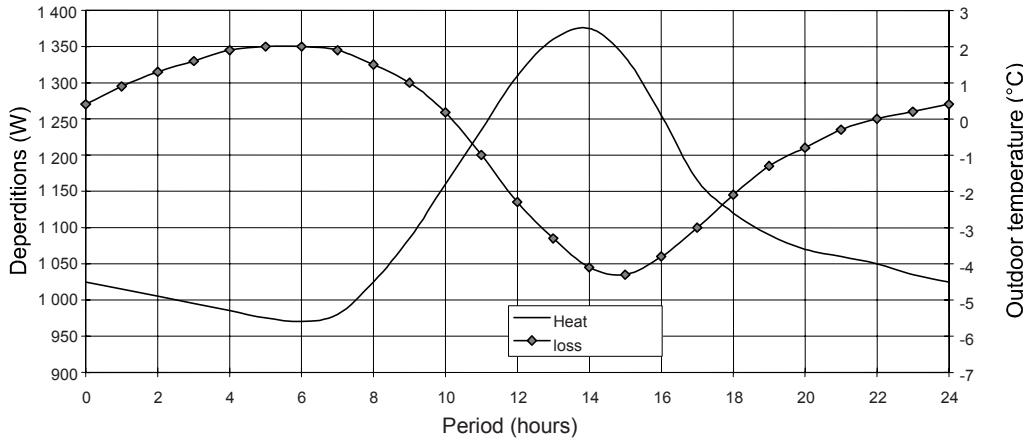


13.5 Test under cold season condition

Definition of a scenario for the outdoor temperature under cold season condition for a classical house (the heat loss are known quantities for an indoor temperature of 20 °C).

Hour	0	1	2	3	4	5	6	7	8	9	10	11
Outside temperature °C	-4,5	-4,7	-4,9	-5,1	-5,3	-5,5	-5,6	-5,4	-4,5	-3,3	-1,8	-0,3
Heat loss W	1 270	1 295	1 315	1 330	1 345	1 350	1 350	1 345	1 325	1 300	1 259	1 200

Hour	12	13	14	15	16	17	18	19	20	21	22	23
Outside temperature °C	1,2	2,2	2,5	1,7	0,1	-1,7	-2,6	-3,2	-3,6	-3,8	-4	-4,3
Heat loss W	1 135	1 085	1 045	1 035	1 060	1 100	1 145	1 170	1 210	1 235	1 250	1 260



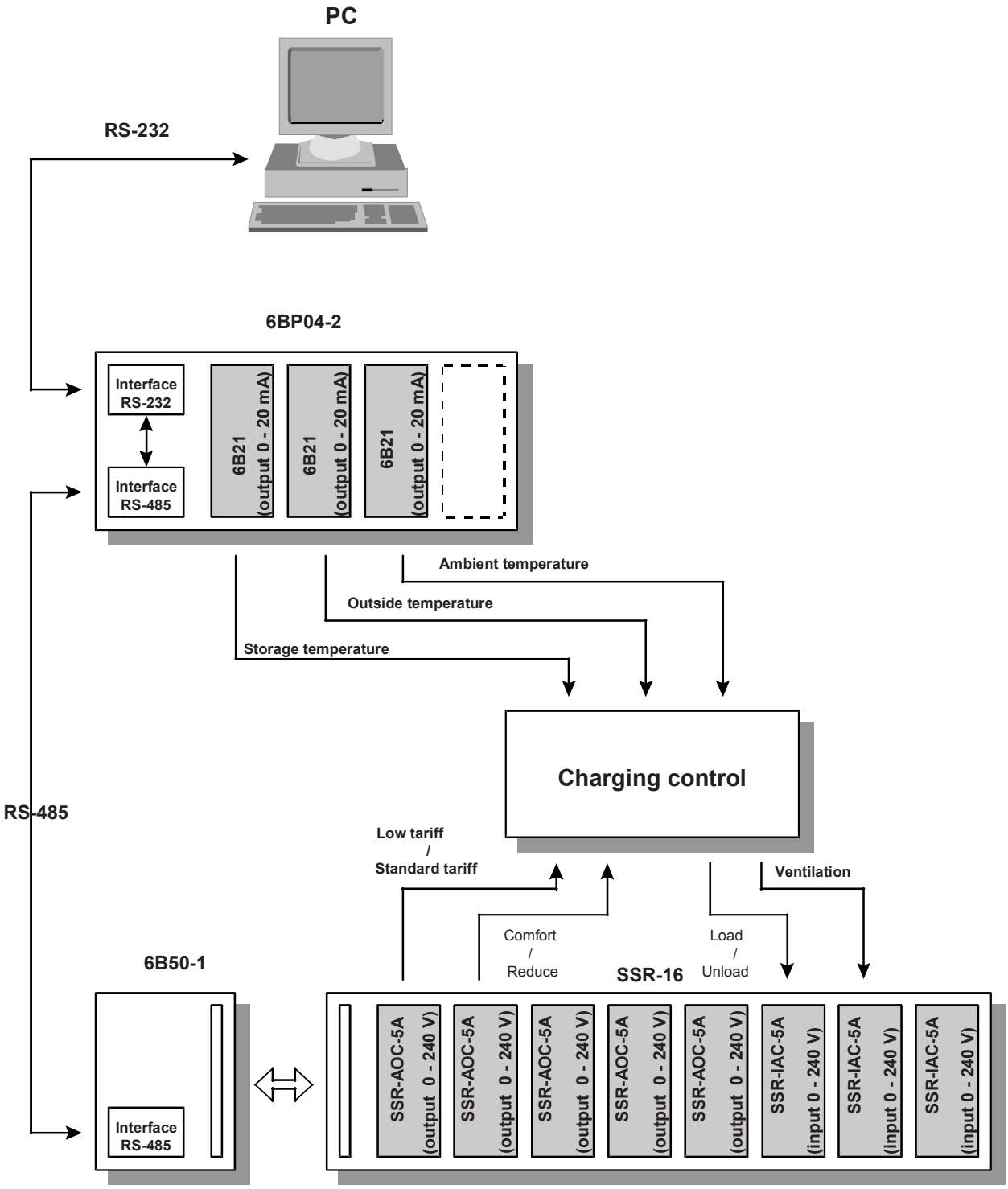
Annex A
(informative)

Information to be given by the manufacturer

	Buying sizing	Installation servicing	Use cleaning
Trademark and type	*	*	
Rated supply voltage	*	*	
Rated power input	*	*	
Classification	*	*	*
Dimensions	*	*	
Mounting and wiring	*	*	*
Settings	*	*	*
Available adjusters	*	*	*
Setting range of adjusters	*	*	*
Servicing and cleaning instructions			*
Configuration		*	*

Annex B
(normative)

Example of the test condition scheme for charging control systems of type D



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