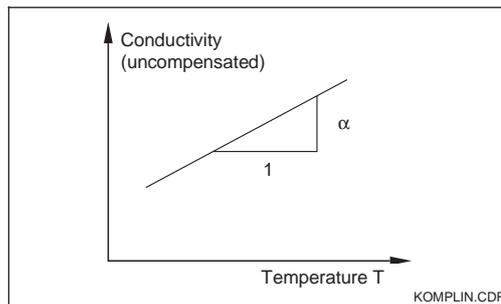## 5.6   Temperature compensation

The temperature coefficient specifies the change in conductivity per degree of temperature change. It depends on the chemical composition of the medium and the temperature itself. In order to compensate for this dependence, four different compensation types can be selected in the transmitter (see field B2):
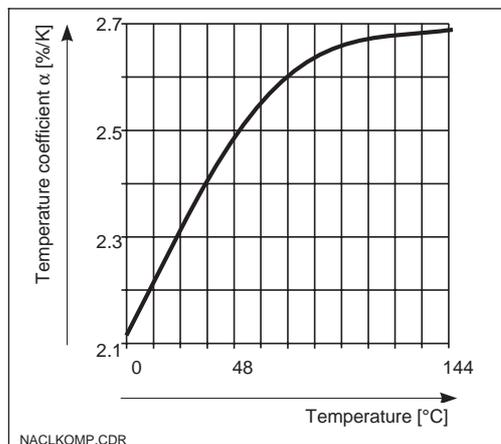
Linear compensation

The change between two temperature points is considered to be constant, i.e. α = const. The α value can be edited for the linear compensation type. The default value for the reference temperature is 25 °C.

KOMPLIN.CDR

NaCl compensation

The NaCl compensation (according to IEC 746) based on a fixed nonlinear curve that defines relationship between the temperature coefficient and the temperature. This curve is used for small concentrations.


NACLKOMP.CDR

Ultrapure water compensation

Just like the NaCl compensation, the ultrapure water compensation is based on a nonlinear curve stored in the instrument.
This curve is split up into NaCl solution and ultrapure water compensation. These are calculated separately but then used together to determine in the overall relationship.

Temperature compensation with table

With using the alpha table function for temperature compensation the following conductivity data of the process medium to be measured is required:
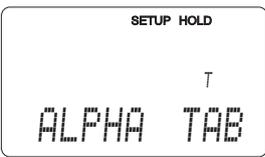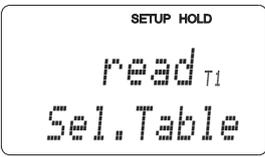
Value pairs from temperature T and conductivity κ for T_0 = 25 °C and for temperatures, which occur in the process.

TAB01E.CDR
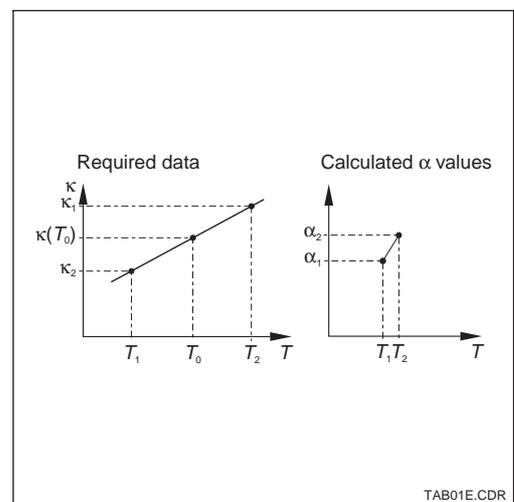
For the temperatures relevant in your process, use the following equation to calculate the α values (not to determine a α value for 25 °C is neither sensible, nor could you edit a table without this value).

$$\alpha = \frac{100}{\kappa(T_0)} \cdot \frac{\kappa(T) - \kappa(T_0)}{T - T_0};\ T \neq T_0.$$

The T-α value pairs obtained are edited in the table in the measuring device and then you can commence measurement.

LM253E5C.CHP

Coding		Field	Selection or range Factory setting (bold)	Display	Info
T		**Function group ALPHA TABLE**		SETUP HOLD T ALPHA TAB	
	T1	Selection of table option	**read** edit	SETUP HOLD read T1 Sel.Table	
	T2	Enter number of table value pairs	**1** 1 ... 10	SETUP HOLD 1 T2 No.Elem.	Up to 10 value pairs can be entered in the α table. These are numbered from 1 ... 10 and can be edited individually or in sequence.
	T3	Selection of table value pair	**1** 1 ... Quantity of table value pairs Asign	SETUP HOLD 1 T3 Sel.Elem.	The function chain T3 ... T5 will run through as many times as correspond to the value in T2. "Asign" appears as the last step. After confirmation, the system jumps to T6.
	T4	Enter temperature value (x value)	**0.0 °C** –35.0 ... 250.0 °C	SETUP HOLD 0.0 °C T4 Temp.val.	The temperature values must have a minimum distance of 1 K. Factory setting for the x value of the table value pairs: 0.0 °C; 10.0 °C; 20.0 °C; 30.0 °C ...
	T5	Enter temperature coefficient α (y value)	**2.10 %/K** 0.00 ... 20.00 %/K	SETUP HOLD 2.10 %/K T5 Alpha val	
	T6	Message whether or not the table status is ok	**yes** no	SETUP HOLD yes T6 Status ok	Only display. If status = "no", then set table correctly (all previous settings are kept) or back to measurement mode (this makes the table invalid).
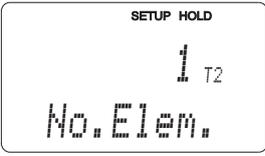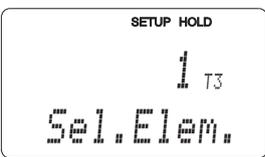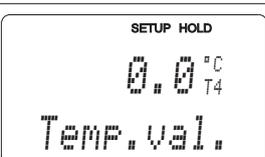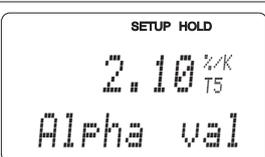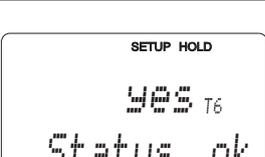
Factory settings are printed in **bold** face;
base version does not include functions in *italic*.

5.7   Concentration measurement

The function group CONCENTRATION is only accessible for instruments equipped with the Plus packet.

The transmitter can convert conductivity values to concentration values. For this, set the operating mode to Concentration Measurement (see Field A1).

Then, you must enter to which basic data the concentration calculation should be based into the measuring device. For the most common substances, the required data is already saved in your device. You can select one of these substances in Field K1.

If you want to specify the concentration of a sample, which is not saved in the device, this is also possible. In this case, you require the conductivity characteristics of the medium. If you do not have this data in the datasheets, you can also determine the characteristics yourself quite simply: Produce samples of the medium in the concentrations in which they appear in the process. Measure the uncompensated conductivity of these samples at temperatures which also occur in the process.

Process temperature changeable:
Should these temperature changes be included in the concentration measurement, then the conductivity of *each* sample created must be measured at least *two different temperatures* (minimum and maximum temperatures of the process).

Process temperature constant:
Measure the differently concentrated samples at this process temperature.

Then you should obtain measuring data looking as follows:
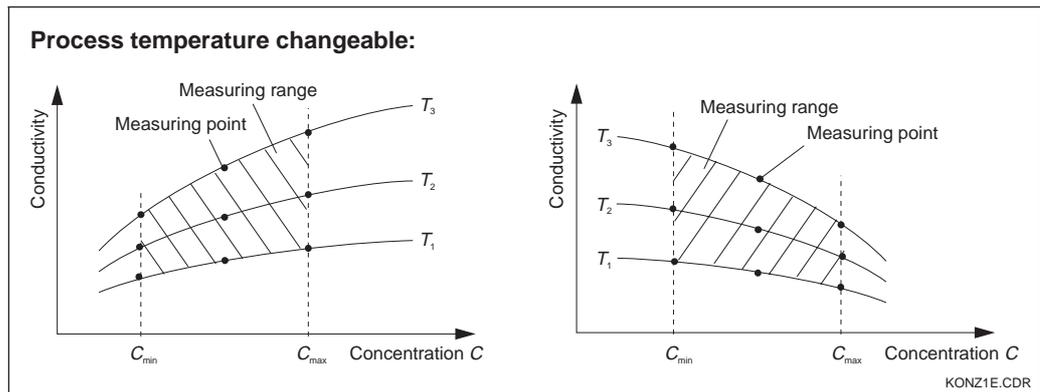
Fig. 5.14   Measured data in the case of changeable temperature (represented qualitatively)

Fig. 5.15   Measured data in the case of constant temperature (represented qualitatively)

Fig. 5.16   Unpermitted curve shapes

The characteristics obtained from the measuring points must have strictly monotonous rising or falling slope in the range of the process conditions, i.e. the may not show the maximum, minimum or ranges of constant behaviour. The curves in the diagram to the left are therefore unpermissible.

Value entry

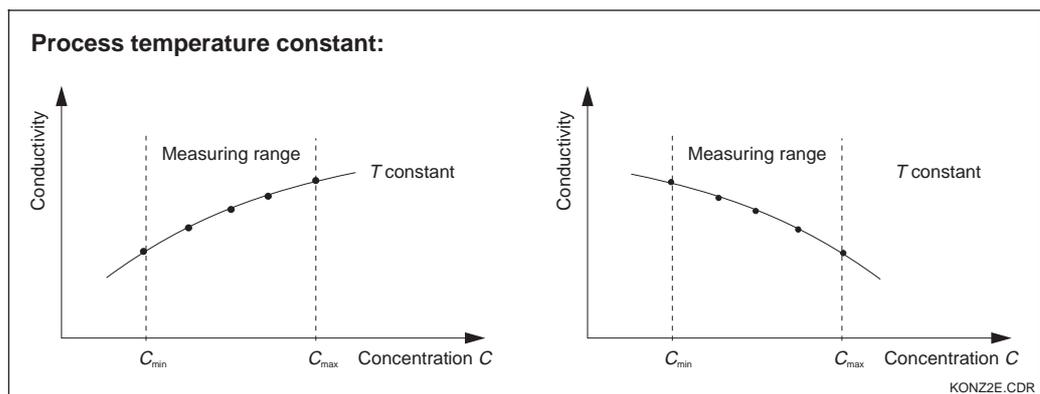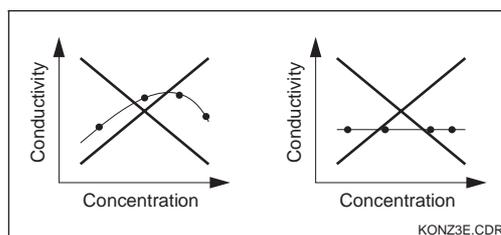Now enter the three parameters in Fields K6 to K8 for each measured sample (value triplet of conductivity, temperature and concentration).

Process temperature changeable:
At least two samples, i.e. two different concentrations, are required. For *each* of these samples, you must enter values for *at least two temperatures* (minimum distance 0.5 °C). The temperature values of the differently concentrated samples must be identical (isothermic characteristics). This provides a minimum of four value triplets.

Process temperature constant:
Enter at least two value triplets in the device. These temperature values of the triplets you enter must be identical.

Note:

If the measured values for conductivity or temperature in measuring operation lie outside the values entered in the concentration table (see Fig. 5.12 and 5.15), this has a negative effect on accuracy and the device generates an error message. Therefore, when determining the characteristics, you should observe the limit values of the process.

If you enter an additional value triplet of 0 µS/cm and 0% for each temperature used, you can work from the start of measuring range with sufficient accuracy and without an error message.

	Coding	Field	Selection or range Factory setting (bold)	Display	Info
K		*Function group CONCENTRATION*		SETUP HOLD K CONCENTRA	*Four different concentration fields can be entered in this function group.*
	K1	*Selection of concentration curve, to be used to calculate the display value*	**1** 1 ... 4	SETUP HOLD 1 K1 act.Curve	*The curves are independent of each other. Therefore, four different curves can be defined.*
	K2	*Selection of table to be edited*	**1** 1 ... 4	SETUP HOLD 1 K2 Table	*When editing a curve, another curve should be used to calculate the corresponding values (see K1).*
	K3	*Selection of table option*	**Read** Edit	SETUP HOLD read K3 Table	*This selection applies to all concentration curves.*
	K4	*Enter number of triplets*	**1** 1 ... 10	SETUP HOLD 1 K4 No.Elem.	*Each triplet consists of three numeric values.*
	K5	*Selection of triplet*	**1** 1 ... Number of triplets in K4	SETUP HOLD 1 K5 Sel.Elem.	*Any triplet can be edited.*

Factory settings are printed in **bold** face;
base version does not include functions in *italic*.

Coding		Field	Selection or range Factory setting (bold)	Display	Info
	K6	*Enter uncompensated conductivity value*	**0.0 µS/cm** 0.0 ... 9999 mS/cm	SETUP HOLD 0.0 µS/cm K6 conduct.	*The function chain K5 ... K8 will run through automatically as many times as corresponds to the value in K4. Then the system jumps to K9.*
	K7	*Enter concentration value for K6*	**0.00 %** 0.00 ... 99.99 %	SETUP HOLD 0.0 % K7 concentr.	*Measuring unit selected as in A2.*
	K8	*Enter temperature value for K6*	**0.0 °C** –35.0 ... 250.0 °C	SETUP HOLD 0.0 °C K8 Temp.val.	
	K9	*Message whether or not the table status is ok*	**yes** no	SETUP HOLD yes K9 Status ok	Only display If not, then set table correctly (all previous settings are kept) or back to measurement mode (this makes the table invalid).

5.8   Service

Coding		Field	Selection or range Factory setting	Display	Info
S		**Function group SERVICE 1**		SETUP HOLD S SERVICE	
	S1	Selection of language	**ENG** = **English** GER = German FRA = French ITA = Italian NEL = Dutch ESP = Spanish	SETUP HOLD ENG S1 Language	This field must be set configured once during device start-up. After confirmation with ENTER you can exit S1 and continue.
	S2	Hold configuration	**S+C** = **during setup and calibration** CAL = during calibration Setup = during setup No = no hold	SETUP HOLD S+C S2 Auto HOLD	S = setup, C = calibration.

Factory settings are printed in **bold** face;
base version does not include functions in *italic*.