



KBCH 120, 130, 140

Differential Protection for Transformers and Generators



Figure 1
KBCH relay

Type KBCH relays offer biased differential current, restricted earth fault and overfluxing protection primarily for the protection of two or three winding power transformers, auto transformers or generator-transformer units. The KBCH provides these features in a very compact and space – efficient case size, for ease of installation.

All models are three phase units with internal vector group compensation and line current transformer ratio correction, thus eliminating the need for interposing transformers.

Up to four biased current inputs per phase can be provided to cater for power transformers with more than two windings and/or more than one circuit breaker controlling each winding, as in mesh or one-and-a-half circuit-breaker busbar arrangements. Versions are available that can accommodate a mixture of 1A (HV) and 5A (LV) CTs, as well as standard models having all 1A or all 5A CTs.

MODELS AVAILABLE

> KBCH120

offers 2 bias inputs per phase for the protection of a two-winding power transformer.

> KBCH130

offers 3 bias inputs per phase for the protection of a three-winding power transformer or a two-winding power transformer with 2 sets of CTs on one winding.

> KBCH140

offers 4 bias inputs per phase.

Customer Benefits

- Biased differential protection
- Restricted earth fault protection
- Overfluxing protection
- Integral CT ratio and vector group compensation
- Measurement of phase, differential and bias currents

All models are available with either 1A or 5A inputs on the primary and secondary side. Alternatively the KBCH 120 and 140 can be provided with 1A CTs on the high voltage windings and 5A CTs on the low voltage windings.

In addition to the biased differential protection, restricted earth fault protection has been included to cover a larger percentage of the transformer windings. Figure 7 shows some typical restricted earth fault applications. The differential protection has been designed to restrain when the transformer is overfluxed so that an instantaneous trip is not issued for transient overfluxing. Since a transformer cannot withstand a severe overfluxing condition indefinitely, time delayed overfluxing protection and an alarm stage has been incorporated.

Contacts that monitor the status of external plant, such as Buchholz protection and temperature measuring devices, can be connected to any of the eight control inputs that are available. Each input can be routed to any number of the output relays via a variable time delay if required.

FUNCTIONS

> Biased differential element

Each relay, contains a biased differential element per phase with a characteristic as shown in Figure 2. The KBCH has a dual slope bias characteristic. The initial slope of 20%, from zero to rated current, ensures sensitivity to faults whilst allowing for up to 15% mismatch when the power transformer is at the limit of its tap range, in addition to current transformer ratio errors. At currents above rated, extra errors may be gradually introduced as a result of CT saturation. The bias slope is therefore increased to 80% to compensate for this.

The current waveform associated with magnetising inrush is characterised by a period of each cycle where its magnitude is very small, as shown in Figure 3. By measuring the time of this period of low current, an inrush condition can be identified. Overfluxing restraint is conditioned by the percentage of fifth harmonic current present.

> High set differential element

An additional high set instantaneous differential element is provided to ensure rapid clearance of heavy faults.

This element is essentially peak measuring to ensure fast operation for internal faults with saturated CTs.

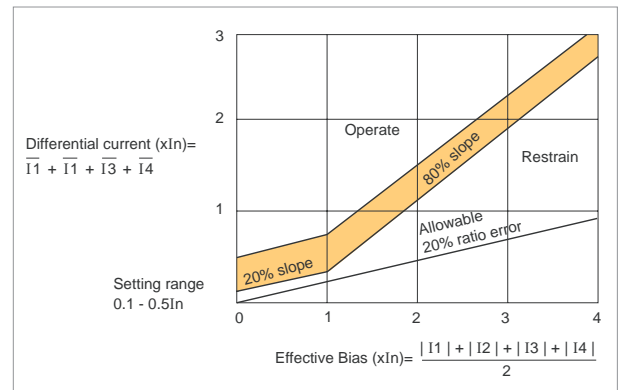


Figure 2 Biased differential characteristic

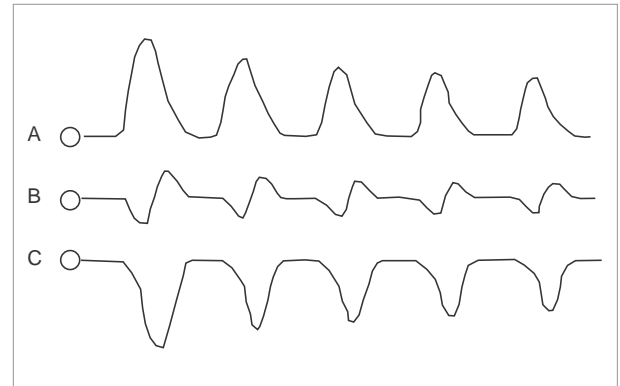


Figure 3 Typical magnetising inrush waveforms

> Restricted earth fault protection

Greater sensitivity for earth faults is obtained by including restricted earth fault protection. A separate element per winding is provided. An externally mounted stabilising resistor will be necessary for optimum performance.

In applications where heavy internal earth fault levels can occur and where a high stabilising resistor setting is used, a voltage limiting, non-linear resistor may be required.

> Overfluxing Alarm and Tripping Protection

A single phase-phase connected voltage input is provided to enable overfluxing detection. Alarm and tripping characteristics, which are based on a measurement of the voltage/frequency ratio, are provided.

The alarm is definite time delayed whilst the trip characteristic may be selected as either definite time, or an IDMT curve (Figure 4).

**Integrated transformer protection
in a small package, for ease
of fitting / retrofitting.**

CONFIGURATION

The setting of logic function links, together with the input and output masks, define the way the relay will operate. This allows:

- Selection of features
- Implementation of user defined logic using auxiliary timers (8 available)
- Control of the integral disturbance recorder.

> Inputs and outputs

KBCH has 8 optically isolated inputs which may be reassigned by the user with any of the available functions from the setting menu.

There are 8 programmable outputs, each comprising a relay with 1 normally open contact.

A dedicated watchdog contact with 1 normally open and 1 normally closed contact is also available.

> Alternative setting group

Two setting groups are provided. This allows the user to set one group to normal operating conditions while a second group may be set to cover alternative operating conditions.

ANCILLARY FUNCTIONS

> Measurements

The relay can display the magnitude of phase currents for each input, differential current and average bias current.

The power system frequency is also displayed.

> Fault records

The fault flags for the last five faults are recorded by the relay. Additional records of the magnitude of the fault currents are also stored for the last fault.

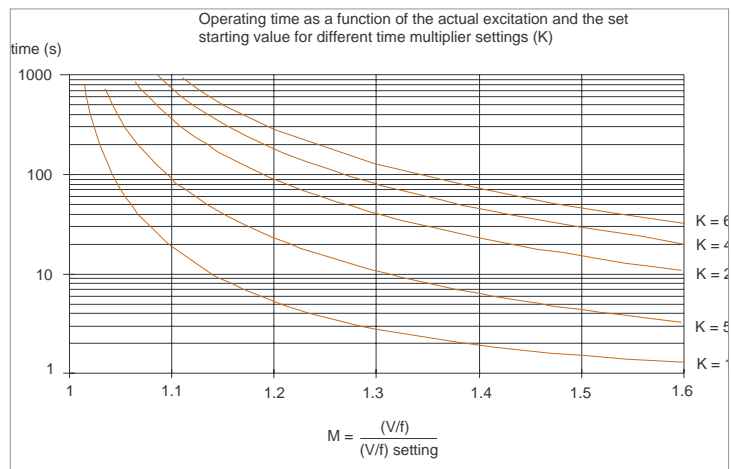


Figure 4 | Inverse time characteristic for overfluxing protection

> Event records

Fifty events can be stored in a buffer. Software is available to allow the events to be accessed remotely by a PC via the communications system.

> Disturbance records (Oscillography)

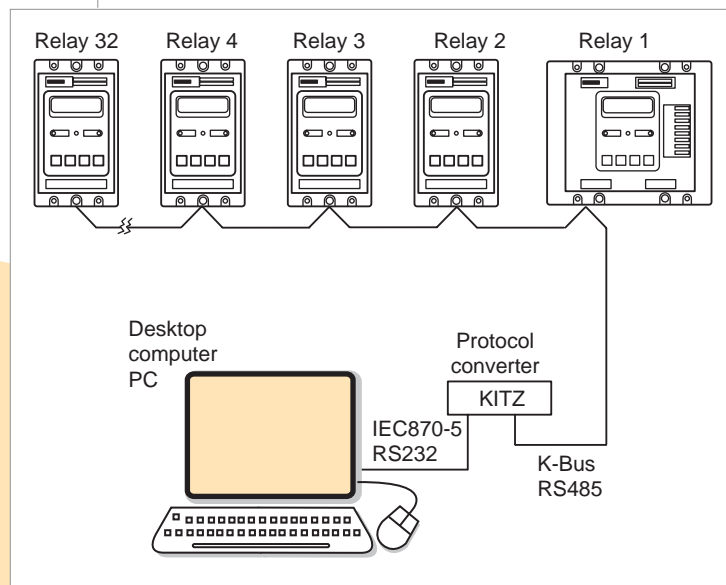
The analogue channels record up to nine phase currents (three per transformer winding) three differential currents, three average bias currents and the voltage.

The digital channels record the status of the output relays and control inputs.

> Power-on diagnostics and self monitoring

Power-on diagnostic tests are carried out by the relay when it is energised. Continuous self-monitoring, in the form of watchdog circuitry and memory checks are also performed. In the event of a failure, the relay will either lock out or attempt a recovery, depending on the type of failure detected.

Figure 5 | Basic communication system



USER INTERFACE

> Front panel user interface

The features of the relay can be accessed through a menu-driven system.

The user can move around the menu by means of the keys on the relay frontplate. This can be done with the cover in place, but any change to the settings requires the cover to be removed.

> Remote access user interface

The menu table can also be accessed via the remote communications facility. This allows all of the menu cells in a column to be displayed simultaneously on the screen of a PC.

> Relay interconnection

The relays can be interconnected via a shielded, twisted wire pair known as K-Bus.

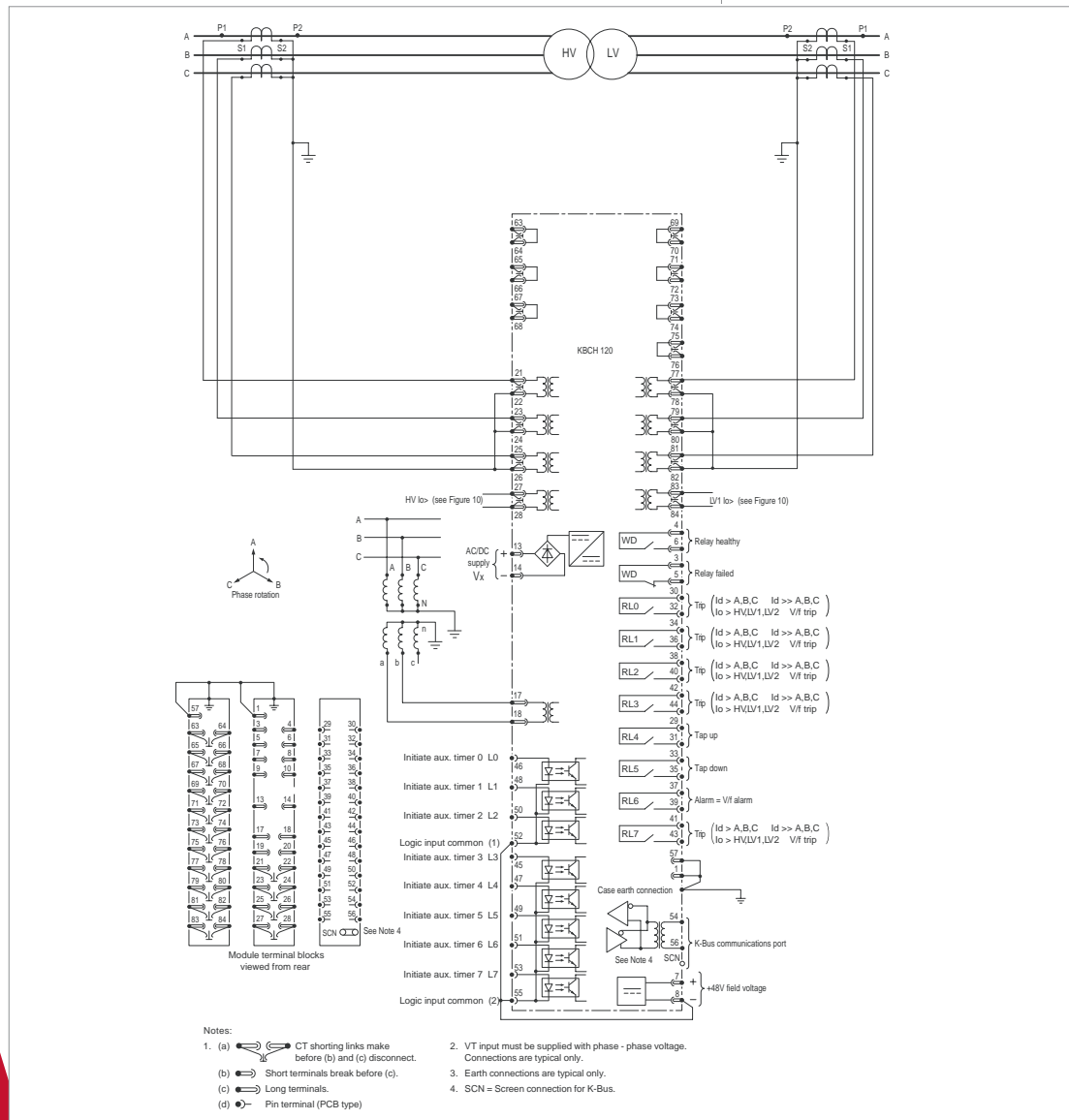
The K-Bus is connected through a protocol converter known as KITZ, either directly or via a modem, to the RS-232 port of the PC.

This system allows up to 32 relays to be accessed through one RS-232 communications port (Figure 5).

> Password protection

Password protection is provided on settings which alter the configuration of the relay, any accidental change to which could seriously affect the ability of the relay to perform its intended function.

Figure 6 Typical application diagram KBCH120



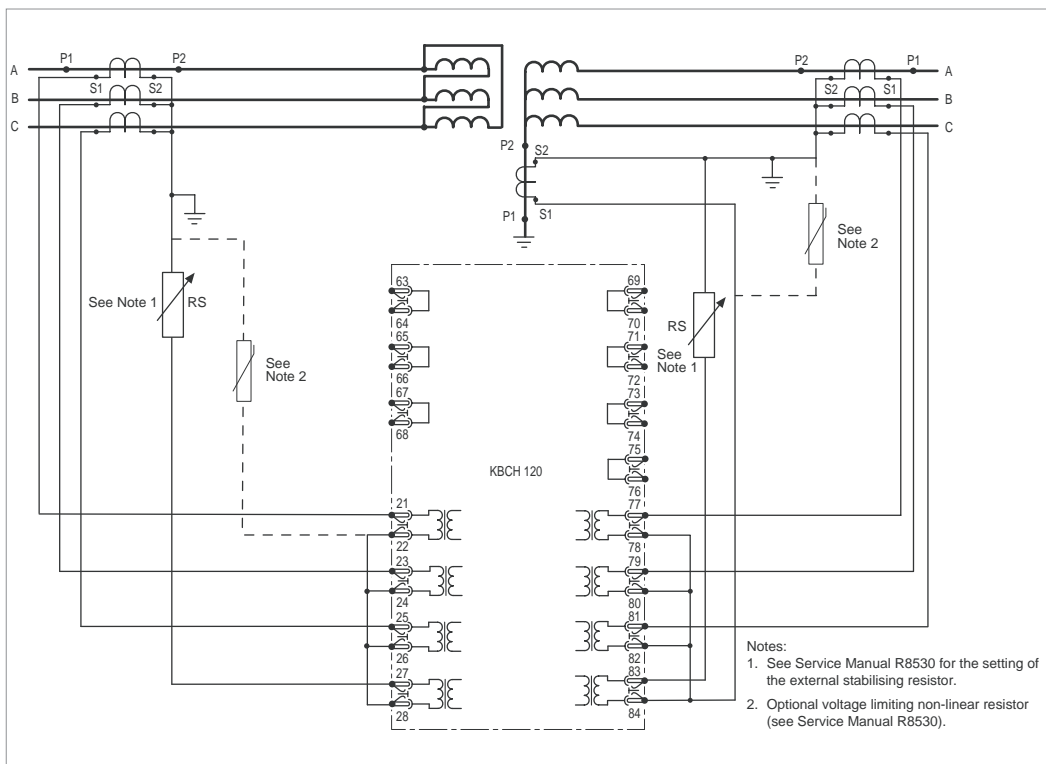


Figure 7
Typical restricted
earth fault connections

> Technical Data

Nominal (Vx)	Operative Range (V)	Absolute Maximum (V)
24–125V dc or 110V 50/60Hz ac	20–150V dc 50–133V ac	190V crest
48–250V dc or 220V 50/60Hz ac	33–300V dc 87–265V ac	380V crest

Field voltage supply for optically
isolated digital inputs
(current limit: 60mA)

48V dc

> Operating time

low set	typically	30 – 35ms
high set	typically	15ms
REF	typically	20 – 40ms

Vector group and ratio correction

HV Ratio Cor (primary)
LV1 Ratio Cor (secondary)
LV2 Ratio Cor (tertiary)
Yy0 (0deg), Yd1 (–30deg), Yd2 (–60deg), Yd3 (–90deg), Yd4 (–120deg), Yd5 (–150deg), Yy6 (+180deg), Yd7 (+150deg), Yd8 (+120deg), Yd9 (+90deg), Yd10 (+60deg), Yd11 (+30deg), Ydy0 (0deg), Ydy6 (+180deg),

HV Ratio Cor (primary)
0.05 to 2 in steps of 0.01

LV1 Ratio Cor (secondary)
0.05 to 2 in steps of 0.01

LV2 Ratio Cor (tertiary)
0.05 to 2 in steps of 0.01

> Digital Inputs

Optically isolated inputs
8 energised from the 48V field voltage

> Contacts

- Output relays 8 single make

> Contact ratings

- Make: 30A and carry for 0.2s
- Carry: 5A continuous
- Break: DC 50W resistive
25W inductive
(L/R = 0.04s)
AC 1250VA
(5A maximum)

> Watchdog relays

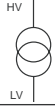
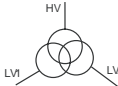
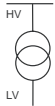

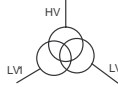
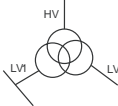
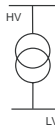
1 make and 1 break

- Make: 10A and carry for 0.2s
- Carry: 5A continuous
- Break: DC 30W resistive
15W inductive
(L/R = 0.04s)
AC 1250VA
(5A maximum)

Subject to maxima of 5A and 300V

Subject to maxima of 5A and 300V

TRANSFORMER CONFIGURATION

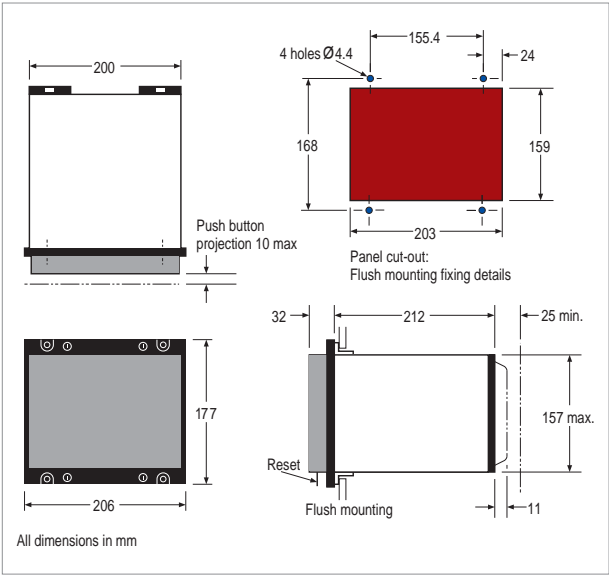
Setting	No. of bias inputs	Configuration	Applicable to:
HV + LV	2		KBCH120/130/140
HV + LV1 + LV2	3		KBCH130/140
HV (x2) + LV	3		KBCH130/140**
HV + LV (x2)	3		KBCH130/140
HV (x2) + LV1 + LV2	4		Only KBCH140
HV + LV1 (x2) + LV2	4		Only KBCH140**
HV (x2) + LV (x2)	4		Only KBCH140

**Transformer, generator or reactor
differential, and busbar protection
(arrangements with up to 4 feeders)**

CASE

The KBCH unit is housed in a size 8 Midos case as shown in Figure 8.

Figure 8
Case outline size 8



INFORMATION REQUIRED WITH ORDER

Unit type	KBCH1	<input type="checkbox"/> 0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 bias inputs per phase		2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 bias inputs per phase		3					
4 bias inputs per phase		4					
Configuration:		<input type="checkbox"/> 0 <input type="checkbox"/> 1					
Standard							
Case Size:		<input type="checkbox"/> W <input type="checkbox"/> 1					
Size 8 Midos flush mounting							
Auxiliary voltage:		<input type="checkbox"/> 2 <input type="checkbox"/> 5					
24/125V							
48/250V							
Rating:		<input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> P					
Vn = 100/120V In = 1A							
Vn = 100/120V In = 5A							
* Vn = 100/120V In = 1A/5A							
Language:		<input type="checkbox"/> E <input type="checkbox"/> F <input type="checkbox"/> G <input type="checkbox"/> S					
English							
French							
German							
Spanish							

* Not available for KBCH 130.

AREVA TRACK RECORD - TRANSFORMER DIFFERENTIAL PROTECTION

- >> Over 34 000 predecessor **MBCH** relays shipped.
- >> Over 10 500 **KBCH** differential relays delivered since launch in 1994.
- >> **MiCOM P63x** series available for fully integrated transformer protection, with extra overcurrent protection and Programmable Logic (PSL).
- >> **KVGC 202** available for voltage regulation (tap change control).

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