

**Knick**

Series 40  
Loop-Powered DC Transformers



# Series 40

## Loop-Powered DC Transformers

Electrical isolation of 0 (4) to 20 mA standard current signals is best carried out by dc isolators which draw their power as voltage drop from the measured signal.

This saves power supplies and cabling, thus improving reliability.

Maximum measurement accuracy, however, requires an isolator concept which fulfills the highest demands.

The application range of loop-powered dc isolators is mainly determined by the following characteristics:

- voltage drop
- operating current
- accuracy
- output voltage
- signal delay
- isolation voltage
- dimensions

Here, the series 40 dc isolation transformers from Knick offer characteristics which have by far not been achieved by other loop-powered dc isolators.

They feature a chopper generator connected in series into the current path and an innovative current conversion technique which gradually changes from sine to square wave over the measuring range (German patent 35 26 997).

This eliminates accuracy-reducing current losses occurring with conventional generators connected in parallel. Voltage drop is decisively reduced, and precise transmission even of smallest currents is assured.

**Model 41** with a voltage drop of 1.2 V is a 1 : 1 isolator for all applications where loop-powered isolators have not been suitable up to now because of technical problems (e.g. voltage drop too high).

**Model 42** with a voltage drop of 0.4 V is a 4:1 isolator for applications where one quarter of the input current is sufficient after the isolation stage, or where the voltage drop is tapped at a load resistor. Due to the 4:1 current reduction only a quarter of the output voltage reacts on the input!

Thus you can design an isolation circuit with an output voltage of 1 V, drawing only 0.65 V from the 20 mA current loop.

**Model 45** with a voltage drop of 2.5 V is a universal 1:1 isolator providing safe isolation according to VDE 0100, part 410. Its module height has been reduced to only 16 mm.

The high output voltage of 27.5 V enables precise power supply isolation for 2-wire transmitters without reducing their voltage swing.

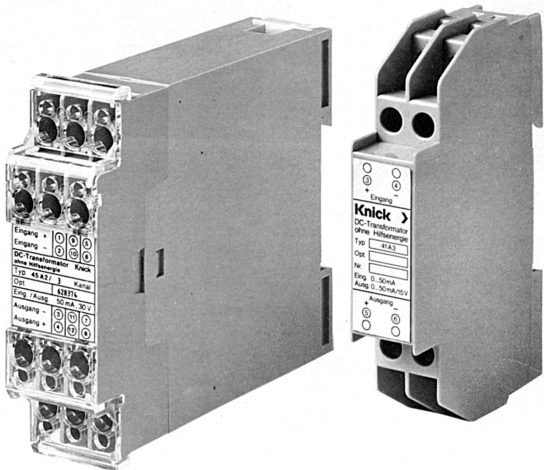
The full encapsulation guarantees highest reliability even under extreme conditions. Quality is assured by computer controlled test methods.

### Key Features

- safe isolation according to VDE 0100, part 410
- no power supply
- no mains interference
- min. voltage drop 0.4 V
- current transmission 2 µA to 50 mA
- input up to 30 V
- output voltage up to 27.5 V
- extremely high accuracy
- small signal delay
- mini solder-in module
- modular mini case, up to 3 channels
- Eurocard up to 8 channels

### Warranty

All defects which occur within 5 years from delivery date shall be eliminated free of charge at our works provided that the equipment is returned postage pre-paid.



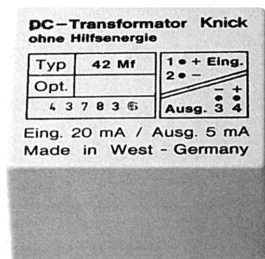
The 22.5 mm wide **A2 modular case** for up to 3 isolators enables multi-channel operation at minimum space.

The **A3 modular case** for one isolator is only 17.5 mm wide.

## Typical Applications

electrical isolation

- of input or output circuits
- of the supply for 2-wire transmitters
- in the case of addition or other combination of measured values at different potentials



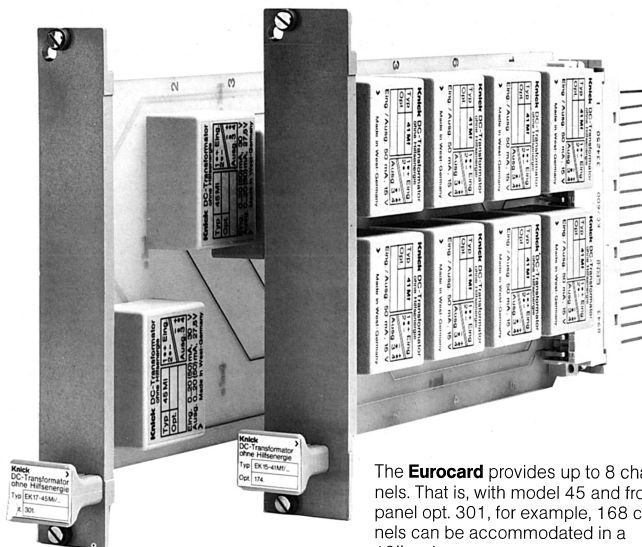
The **module's** small dimensions enable completely new applications on printed circuit boards or with compact instruments such as head-mounted 2-wire transmitters.

- in order to eliminate currents resulting from double grounding
- in the case of insufficient insulation and test voltage
- of signal sources at a high potential
- in battery-operated instruments with a central battery



## Contents

	Page
Technical Data	4
Clearances	6
Isolation Voltages	7
Model Range	9
Block Diagrams	10
Transformation Curves	
Typical Configurations	12
Dimension Drawings/ Terminal/Pin Assignments	14



The **Eurocard** provides up to 8 channels. That is, with model 45 and front panel opt. 301, for example, 168 channels can be accommodated in a 19" rack.

## Production Range for Measurement and Control:

measuring amplifiers  
temperature transmitters  
modules for electrical isolation  
loop-powered indicators  
current/voltage calibrators  
DC measuring instruments

Technical Data

Modular Case / Module

	Model 41	Model 45	Model 42
input	0 to 20 mA 0 to 50 mA	0 to 20 mA 0 to 50 mA	0 to 20 mA
output	0 to 20 mA/max. 15 V 0 to 50 mA/max. 15 V	0 to 20 mA/max. 27.5 V 0 to 50 mA/max. 26.5 V	0 to 5 mA/max. 15 V
operating current	< 2 µA	< 2 µA	< 50 µA
voltage drop	approx. 1.2 V (20 mA) approx. 1.6 V (50 mA)	approx. 2.5 V (20 mA) approx. 3.5 V (50 mA)	approx. 400 mV (20 mA)
ripple <sup>1)</sup>	< 1.5 mV <sub>pp</sub> /mA	< 1.5 mV <sub>pp</sub> /mA	< 2 mV <sub>pp</sub> /mA
rise/fall time	approx. 2.5 ms for 500 Ω load	approx. 2.5 ms for 500 Ω load	2.5 ms for 1 kΩ load
chopper frequency	approx. 100 kHz	approx. 150 kHz	approx. 100 kHz
overload	100 mA V <sub>in</sub> limited to approx. 20 V	100 mA V <sub>in</sub> limited to approx. 33 V	100 mA V <sub>in</sub> limited to approx. 8 V
test voltage	2.5 kVac	4 kVac	2.5 kVac
protection against electrical shock	---	safe isolation against rated voltages up to 380 V for protection by functional extra-low voltage in compliance with VDE 0100, part 410 <sup>2)</sup>	---
transmission error <sup>3)</sup>	< 5 µA ± 2 · 10 <sup>-4</sup> of meas. val.	< 5 µA ± 2 · 10 <sup>-4</sup> of meas. val.	< 5 µA ± 5 · 10 <sup>-4</sup> of meas. val. (at output)
load error	< 2 · 10 <sup>-4</sup> of measured value per 100 Ω		
total error <sup>4)</sup>	< 5 µA ± 0.2 % of measured value		
input capacitance	1 µF		
output capacitance	1 µF		
surge withstand	5 kV, 1.2/50 µs according to IEC 255-4 8 kV according to IEC 801-2		
ambient temperature	– 25 to + 80 °C		
versions	Mf module (models 41/42) height 19.6 mm		
	Mi module (models 45) height 16 mm		

<sup>1)</sup> for load < 5 Ω ripple can be slightly higher  
<sup>2)</sup> refers to inputs against outputs

<sup>3)</sup> temperature range – 10 to + 70 °C  
<sup>4)</sup> includes all errors in the range – 25 to + 80 °C, load 0 to 500 Ω

## (continued)

version	<p>modular case</p> <p>A 2: width 22.5 mm, max. 3 isolators, polycarbonate with snap-on mounting for 35 mm DIN rail (DIN EN 50 022) or M 4 screw mounting protection (as per DIN 40 050): case IP 40 terminals IP 20</p> <p>A 3: width 17.5 mm, max. 1 isolator, polycarbonate with snap-on mounting for 35 mm DIN rail (DIN EN 50 022) protection (as per DIN 40 050): case IP 40 terminals IP 20</p>
dimensions	see dimension drawings
weight	<p>version Mf, Mi approx. 40 g</p> <p>version A 2 with 1 isolator: approx. 140 g</p> <p>version A 2 with 2 isolators: approx. 190 g</p> <p>version A 2 with 3 isolators: approx. 210 g</p> <p>version A 3: approx. 70 g</p>

## Eurocard

## Eurocard

	EK 15	EK 17
equipment	up to 8 modules	up to 4 modules, only for model 45 Mi
protection against electrical shock	---	safe isolation against rated voltages up to 380 V for protection by functional extra-low voltage in compliance with VDE 0100, part 410 <sup>1)</sup>
plug connector	type F as per DIN 41 612	type F as per DIN 41 612
socket connector <sup>2)</sup>	type F as per DIN 41 612	type F as per DIN 41 612
front panel	<p>opt. 174: INTERMAS SP/K3-n05T polycarbonate, grey</p> <p>opt. 301: INTERMAS SP/K3-n04T polycarbonate, grey</p>	<p>opt. 301: INTERMAS SP/K3-n04T polycarbonate, grey</p>

For further technical data see page 4.

<sup>1)</sup> refers to inputs against outputs and inputs against each other

<sup>2)</sup> The socket connector is included in the supply range.

# Clearances

as per VDE 0110 (inhomogeneous field)

## Modular Case

version	inputs against each output	inputs (outputs) against each other
A 2 with 1 isolator	> 26 mm	---
A 2 with 2 isolators	> 26 mm	> 8 mm
A 2 with 3 isolators	> 26 mm	> 4 mm
A 3	> 32 mm	---

## Module

model	input against output
41 Mf, 42 Mf, 45 Mi	≥ 18 mm

## Eurocard

model	inputs against each other and against each output	outputs against each other
EK 15, models 41 Mf/42 Mf/45 Mi ≤ 4 modules	> 6.4 mm	> 6.4 mm
EK 15, models 41 Mf/42 Mf/45 Mi ≥ 5 modules	> 3.2 mm	> 3.2 mm
EK 17, model 45 Mi	> 13.0 mm	> 3.6 mm

# Isolation Voltages

and permissible pollution degrees as per VDE 0110

## Modular Case

Model 41/42	input against output of same isolator	inputs against other outputs	inputs (outputs) against each other
version A 2 with 1 isolator	500 Vdc/degree 3	---	---
version A 2 with 2 isolators	500 Vdc/degree 3	2000 V/degree 1 1900 V/degree 2 630 V/degree 3	2000 V/degree 1 1400 V/degree 2 630 V/degree 3
version A 2 with 3 isolators	500 Vdc/degree 3	2000 V/degree 1 1200 V/degree 2 630 V/degree 3	1900 V/degree 1 700 V/degree 2 440 V/degree 3
version A 3	500 Vdc/degree 3	---	---

## Model 45<sup>1)</sup>

version A 2 with 1 isolator	1000 Vdc/degree 2 630 Vdc/degree 3	---	---
version A 2 with 2 isolators	1000 Vdc/degree 2 630 Vdc/degree 3	2000 V/degree 2 630 V/degree 3	2000 V/degree 1 1400 V/degree 2 630 V/degree 3
version A 2 with 3 isolators	1000 Vdc/degree 2 630 Vdc/degree 3	2000 V/degree 1 1700 V/degree 2 630 V/degree 3	1900 V/degree 1 700 V/degree 2 440 V/degree 3
version A 3	1000 Vdc/degree 2 630 Vdc/degree 3	---	---

## Module

Model 41/42	input against output
version Mf	500 Vdc/degree 4
Model 45 <sup>1)</sup>	
version Mi	1000 Vdc/degree 3 500 Vdc/degree 4

<sup>1)</sup> According to VDE 0160 pollution degrees 3 and 4 are not permissible for creepage distances and clearances which have to effect safe isolation.

# Isolation Voltages

and permissible pollution degrees as per VDE 0110

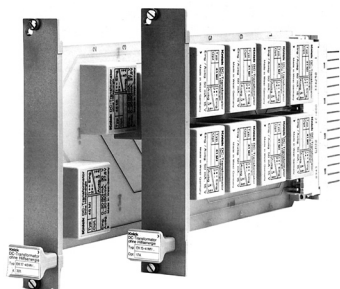
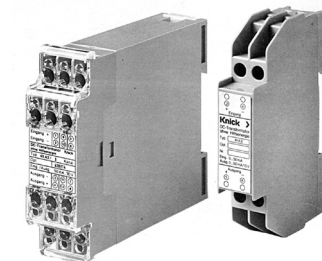
## Eurocard

Model	input against output of same module	inputs against other inputs and outputs	outputs against each other
EK 15, models 41 Mf/42 Mf ≤ 4 modules	500 Vdc/ degree2 400 Vdc/degree 3 200 Vdc/degree 4	1700 V/degree 1 720 V/degree 2 400 V/degree 3 200 V/degree 4	1700 V/degree 1 720 V/degree 2 400 V/degree 3 200 V/degree 4
EK 15, models 41 Mf/42 Mf ≥ 5 modules	500 Vdc/degree 1 360 Vdc/ degree2 200 V /degree 3 50 V /degree 4	1000 V/degree 1 360 V/degree 2 200 V/degree 3 50 V/degree 4	1000 V/degree 1 360 V/degree 2 200 V/degree 3 50 V/degree 4
EK 15, model 45 Mi ≤ 4 modules	1000 Vdc/degree 1 720 Vdc/ degree2 400 Vdc/degree 3 200 V /degree 4	1700 V/ degree1 720 V/degree 2 400 V/degree 3 200 V/degree 4	1700 V/degree 1 720 V/degree 2 400 V/degree 3 200 V/degree 4
EK 15, model 45 Mi ≥ 5 modules	1000 Vdc/degree 1 360 V /degree 2 200 V /degree 3 50 V /degree 4	1000 V/degree 1 360 V/degree 2 200 V/degree 3 50 V/degree 4	1000 V/degree 1 360 V/degree 2 200 V/degree 3 50 V/degree 4
EK 17, model 45 Mi <sup>1)</sup>	1000 Vdc/degree 2 820 Vdc/degree 3 410 Vdc/degree 4	2100 V/degree 1 1300 V/degree 2 820 V/degree 3 410 V/degree 4	1100 V/degree 1 360 V/degree 2 225 V/degree 3 80 V/degree 4

<sup>1)</sup> According to VDE 0160 pollution degrees 3 and 4 are not permissible for creepage distances and clearances which have to effect safe isolation.



## Model Range



### Modular Case

Version	Number of Isolators	Ref. No.		
A 2 modular case (width 22.5 mm)	1	41 A 2/1	42 A 2/1	45 A 2/1
	2	41 A 2/2	42 A 2/2	45 A 2/2
	3	41 A 2/3	42 A 2/3	45 A 2/3
A 3 modular case (width 17.5 mm)	1	41 A 3	42 A 3	45 A 3

### Module

Mf module (height 19.6 mm)	41 Mf
Mf module (height 19.6 mm)	42 Mf
Mi module (height 16 mm)	45 Mi

### Eurocard

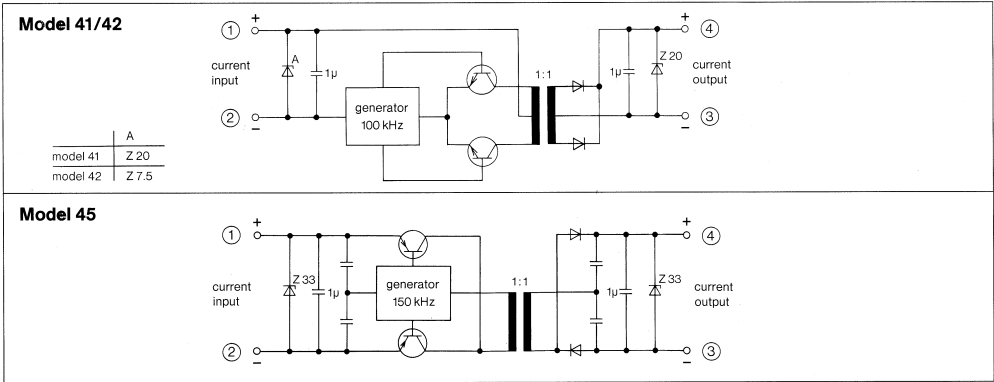
EK 15 Eurocard	max. 8	EK 15-41 Mf/... <sup>1)</sup> EK 15-42 Mf/... <sup>1)</sup> EK 15-45 Mi/... <sup>1)</sup>
EK 17 Eurocard	max. 4	EK 17-45 Mi/... <sup>1)</sup>

<sup>1)</sup> Please fill in desired number of modules when ordering.  
For replacement, model EK 5... is still available.

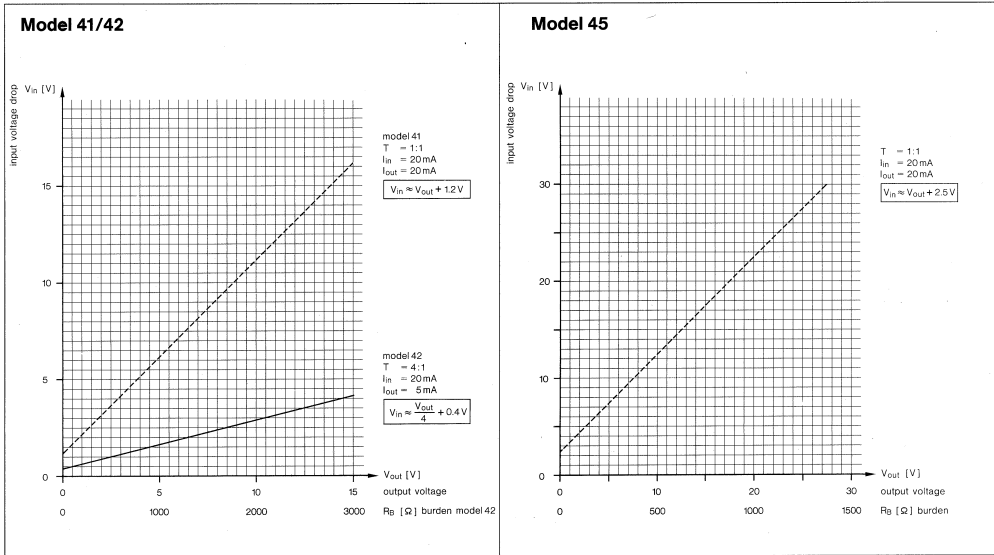
### Options

Options	Ref. No.
INTERMAS front panel (width 25 mm) for EK 15 Eurocard, mounted	174
INTERMAS front panel (width 20 mm) for EK 15 or EK 17 Eurocard, mounted (can only be equipped with model 45 Mi)	301

Block Diagrams

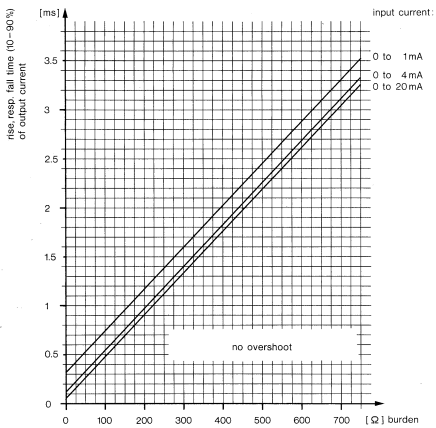


Transformation Curves

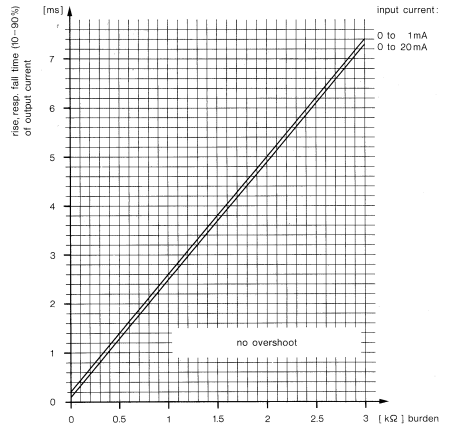


## Reaction to a Square-Wave Pulse of the Input Current

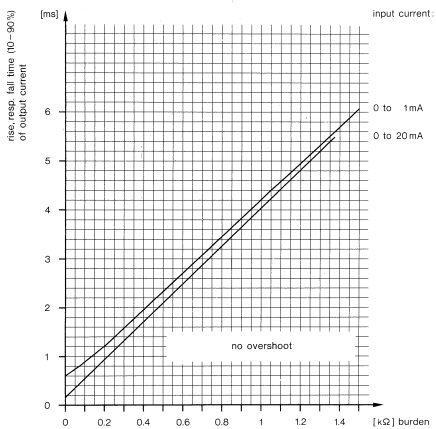
**Model 41**



**Model 42**



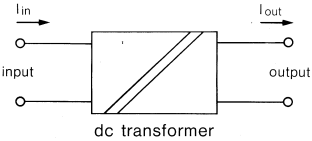
**Model 45**



Typical Configurations

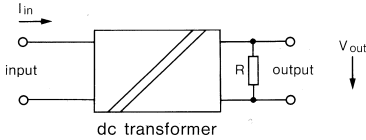
1. isolation with  
impressed current,  
current output

models 41/45:  $I_{out} = I_{in}$   
model 42:  $I_{out} = I_{in}/4$

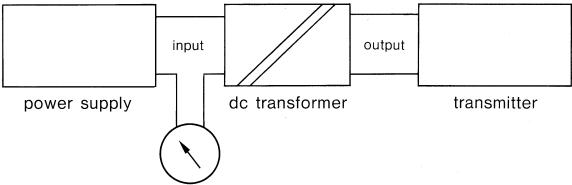


2. isolation with  
impressed input current,  
voltage output

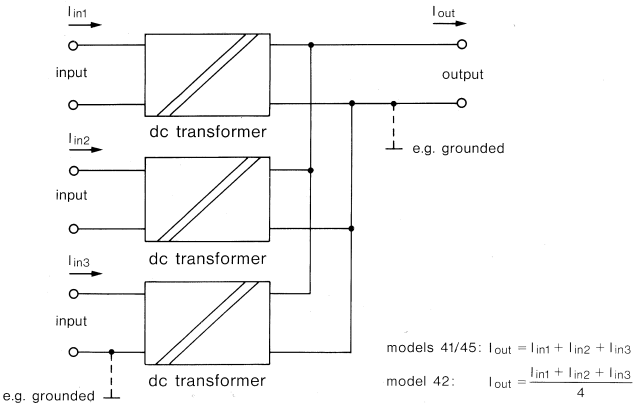
models 41/45:  $V_{out} = R \cdot I_{in}$   
model 42:  $V_{out} = \frac{R \cdot I_{in}}{4}$



3. isolation for  
two-wire configuration  
(preferably model 45)



4. isolation for addition  
of impressed currents



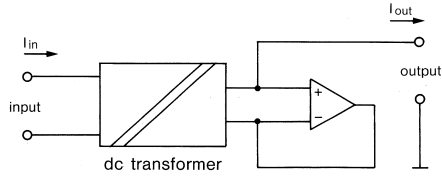
models 41/45:  $I_{out} = I_{in1} + I_{in2} + I_{in3}$   
model 42:  $I_{out} = \frac{I_{in1} + I_{in2} + I_{in3}}{4}$

## 5. isolation in combination with operational amplifier circuits

### 5.1 isolation in short-circuit mode, current output referred to ground

models 41/45:  $I_{out} = I_{in}$

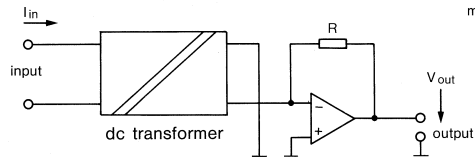
model 42:  $I_{out} = I_{in}/4$



### 5.2 isolation with impressed input current and low-resistance voltage output

models 41/45:  $V_{out} = R \cdot I_{in}$

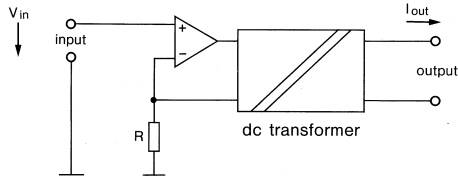
model 42:  $V_{out} = \frac{R \cdot I_{in}}{4}$



### 5.3 isolation with high-resistance voltage input and impressed input current

models 41/45:  $I_{out} = \frac{V_{in}}{R}$

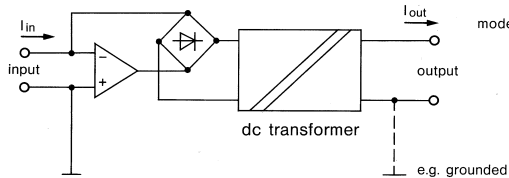
model 42:  $I_{out} = \frac{V_{in}}{4R}$



### 5.4 isolation with precision full-wave rectification, impressed input and output current

models 41/45:  $I_{out} = |I_{in}|$

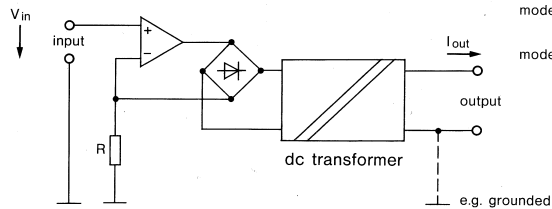
model 42:  $I_{out} = \frac{|I_{in}|}{R}$



### 5.5 isolation with precision rectification, high-resistance voltage input, impressed output current

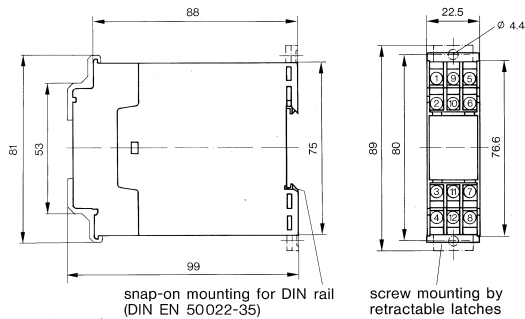
models 41/45:  $I_{out} = \frac{|V_{in}|}{R}$

model 42:  $I_{out} = \frac{|V_{in}|}{4R}$



Dimension Drawings/  
Terminal and Pin Assignments

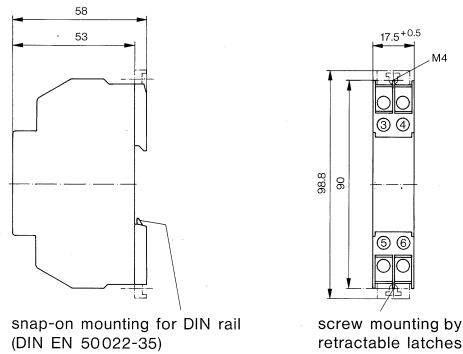
Version A 2



channel 1	1 input	+
	2 input	-
	3 output	-
	4 output	+
channel 2	5 input	+
	6 input	-
	7 output	-
	8 output	+
channel 3	9 input	+
	10 input	-
	11 output	-
	12 output	+

M 3 × 8 terminal screws with self-releasing clamping pieces, max. terminal cross-section solid: 2 × 1.5 mm<sup>2</sup> stranded wire with sleeve: 2 × 1.0 mm<sup>2</sup>

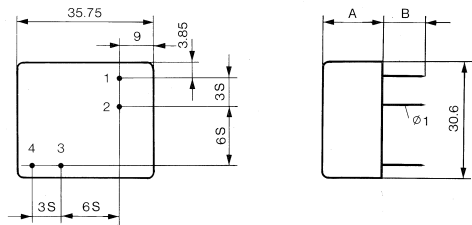
Version A 3



3 input	+
4 input	-
5 output	+
6 output	-

M 3.5 terminal screws with self-releasing clamping pieces, max. terminal cross-section solid: 2 × 2.5 mm<sup>2</sup> stranded wire with sleeve: 2 × 1.5 mm<sup>2</sup> (DIN 46228)

Version Mf/Mi



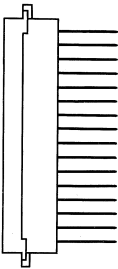
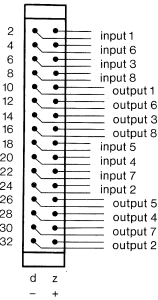
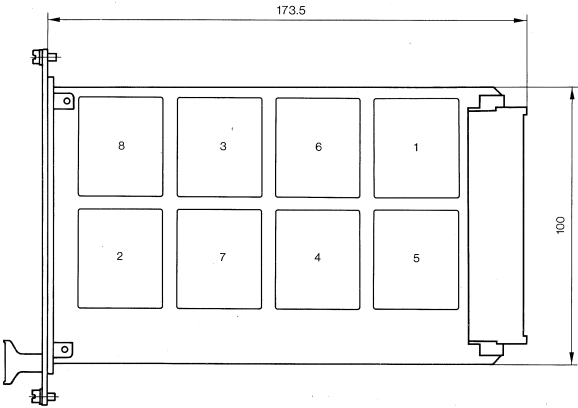
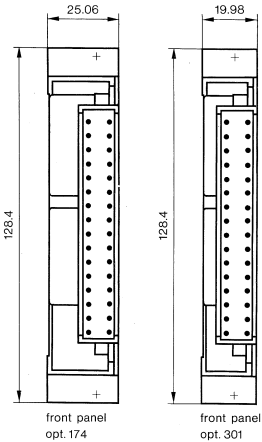
1 input	+
2 input	-
3 output	-
4 output	+
S = spacing = 2.54	

	Mf	Mi
A	19.6	16
B	approx. 6.8	approx. 10.4

subject to change

**Dimension Drawings and Contact Assignments**

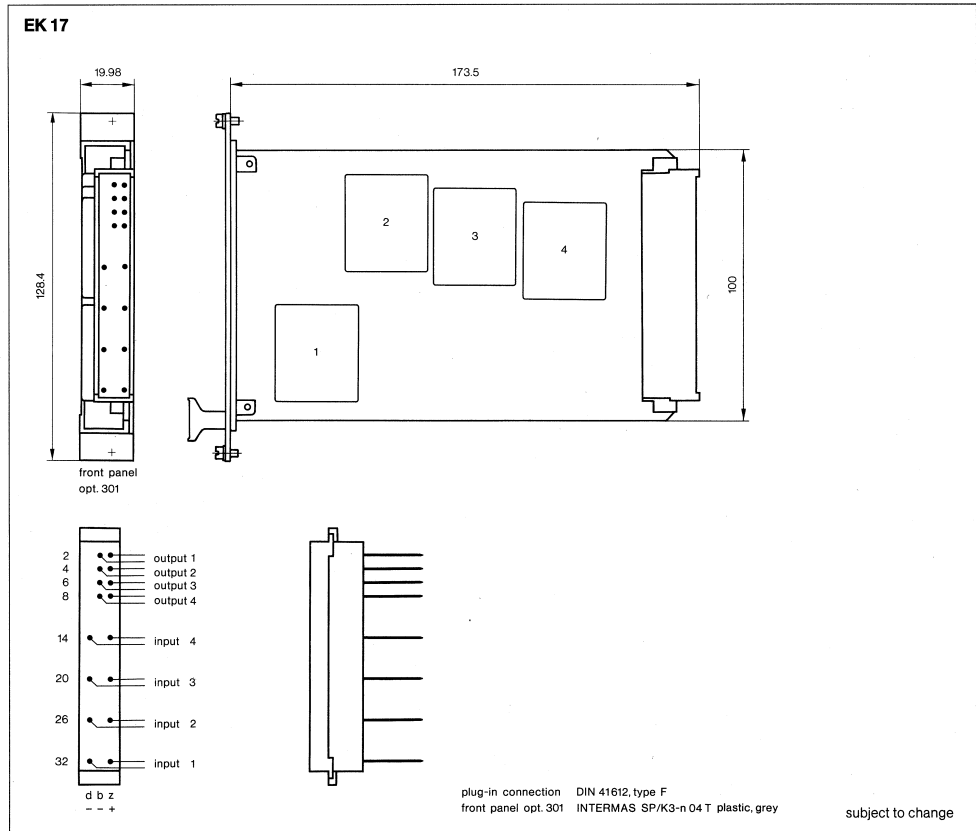
**EK 15**



plug-in connection      DIN 41612, type F  
front panel opt. 174      INTERMAS SP/K3-n05T plastic, grey  
front panel opt. 301      INTERMAS SP/K3-n04T plastic, grey



### Dimension Drawings and Contact Assignments



**Knick**  
**Elektronische Messgeräte**  
**GmbH & Co. KG**  
 Beuckestraße 22, 14163 Berlin  
 Postfach 37 04 15, 14134 Berlin

Telefon: +49 (0)30-801 91-0  
 Telefax: +49 (0)30-801 91-200  
 E-Mail: [knick@knick.de](mailto:knick@knick.de)  
 Internet: [www.knick.de](http://www.knick.de)