

High Voltage Filters



Installation and User Manual

Rev. e1.05

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I Introduction

Partial Discharge (PD) measurements are conducted in frequency ranges, which are partly covered by radio transmission. Further, impulse noise interference hamper sensitive measurements. Besides using small filters in the acquisition chain, power filters allow removing such disturbance from the high voltage supply. Power Diagnostix offers a range of different high voltage filters for various applications.

II Safety instructions

Before using a filter, read the following safety information in this manual carefully. In particular read and follow the information, which are marked with the words 'Warning'. This word is reserved for conditions and actions that pose hazards to the user.

Always obey the safety rules given with the warnings and in this chapter. Make sure to take care of the safety issues while performing field measurements. Never disregard safety considerations even under the time constraints often found with on-line and off-line tests on site.



Warning:

- Always provide solid grounding of the filter. Use the multi-contact connectors on its base plate. Never operate the filter without protective grounding.
- Avoid working alone.
- Do not allow the filter to be used if it is damaged or its safety is impaired.
- Inspect the ground leads and signal cables for continuity.
- Select the proper coupling circuit and connection for your application.
- Do not use the instrument in an environment at risk of explosion.

When working with instruments and/or accessories under high voltage, a minimum working distance must be kept to prevent physical harm or damage. The following table shows minimum working distances depending on the measuring system voltage according to DIN EN 50110-1.

System Voltage kV	Minimum Working Distance mm
<1	200
10	350
20	400
36	580
70	900
132	1100
275	1800
480	3200

III General installation instructions

In order to connect the filter to a high voltage (HV) source and to the device under test, high voltage cables with multi-contact (MC) connectors are needed. Power Diagnostix can provide such connecting cables that are ready to use. In case the cables are assembled on-site by non-Power Diagnostix personnel, please refer to the assembly instructions for MC connectors.

Warning: For protection against electric shock, parts must be isolated from the power supply while being assembled or disassembled.

Connect the filter to the HV supply and the device under test. Please make sure that the cables do not touch the ground and be aware of the special MC locking system that is based on the "push-pull" principle. It is self-locking when connected. For disconnection first push and then pull the MC connector.

Warning: Connectors may not be connected or disconnected under load.

After establishing the connection from HV supply and to the device under test, provide appropriate grounding connections. It's recommended not use normal cable but flat copper tape for this purpose.

As a general rule: Avoid sharp edges and corners in your measurement setup, as they increase the risk of uncontrolled discharges.

IV T-Filters

IV.1 Introduction

Power Diagnostix's T-filters are designed to reduce high frequent disturbance signals from the high voltage supply. Their main application is induced voltage testing on motors and large power transformers. Their basic structure is a T-filter with a ground capacitor of 10 nF and two coils. The standard filters come with B18N (multi-contact, MC) connectors, but other connectors are available on request. With their ground plate on wheels the filters can be easily moved and are ideal for flexible test set-ups.

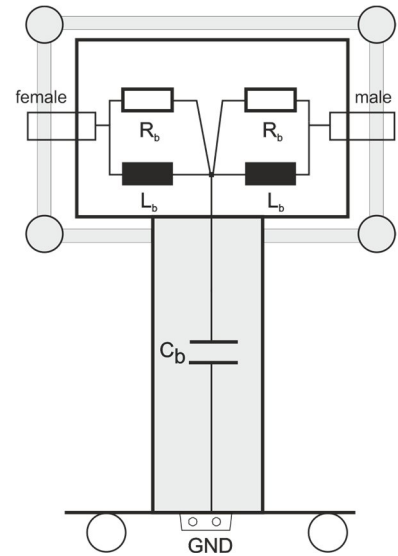


Figure IV.1: Design of a T-filter

IV.2 Installation

The following figure shows a typical setup with Power Diagnostix T-filters.

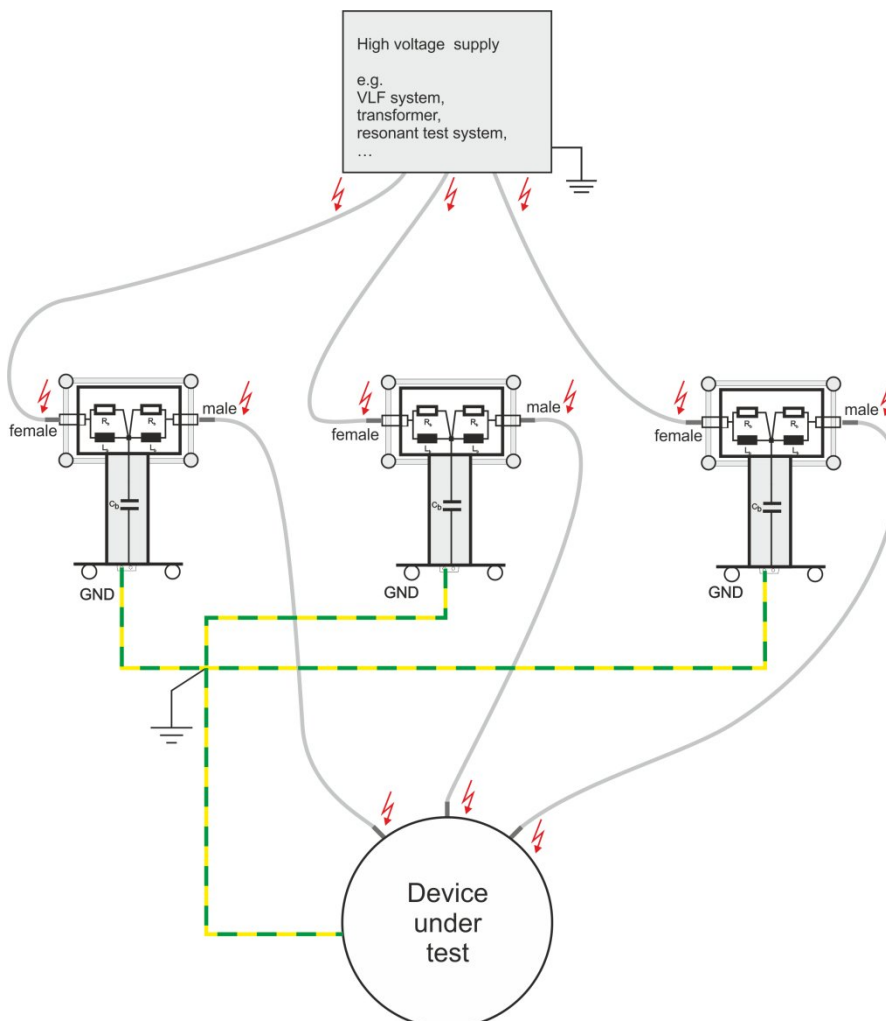


Figure IV.2: Connections of an example test setup for 3-phase testing with T-filters

IV.3 Operation

Every T-filter is marked with a plaque specifying the voltage and current that the filter can take. U_N stands for the nominal voltage, while I_{Ncont} specifies the maximum current with which the filter can be operated continuously. In order to prevent damage from heat, the filter must be switched off after that maximum duration time to cool down.

The following table shows voltage and current values for Power Diagnostix's standard T-filters.

Model	U_N	I_{Ncont}
T30/1	30 kV	1 A
T30/5	30 kV	5 A
T30/20	30 kV	20 A
T30/100	30 kV	80 A
T50/1	50 kV	1 A
T50/5	50 kV	5 A
T50/20	50 kV	20 A
T50/100	50 kV	80 A
T100/1	100 kV	1 A
T100/5	100 kV	5 A
T100/20	100 kV	20 A
T100/100	100 kV	80 A

Table 1: Voltage and current values for standard T-filters

IV.4 Technical data

IV.4.1 T30/x

Nominal voltage: See Table 1

Nominal current: See Table 1

Typical frequency range: 0–300 Hz

Typical 50Ω-insertion loss:

kHz	10	20	50	100	200	500	1000
dB	8	12	14	25	45	>60	>60

Connectors: B18N (multi-contact) or other on request

Dimensions in mm:

Whole filter (W x H x D):

T30/1	T30/5	T30/20	T30/100
357 x 620 x 357	357 x 620 x 357	357 x 620 x 357	507 x 620 x 457

Dimensions in mm:

Top box (W x H x D):

T30/1	T30/5	T30/20	T30/100
350 x 250 x 350	350 x 250 x 350	350 x 250 x 350	507 x 250 x 457

Weight: Approx. 35 kg

IV.4.2 T50/x

Nominal voltage: See Table 1

Nominal current: See Table 1

Typical frequency range: 0–300 Hz

Typical 50Ω-insertion loss:

kHz	10	20	50	100	200	500	1000
dB	8	12	14	25	45	>60	>60

Connectors: B18N (multi-contact) or other on request

Dimensions in mm:

Whole filter (W x H x D):

T50/1	T50/5	T50/20	T50/100
357 x 800 x 357	357 x 800 x 357	357 x 800 x 357	507 x 800 x 457

Dimensions in mm:

Top box (W x H x D):

T50/1	T50/5	T50/20	T50/100
350 x 250 x 350	350 x 250 x 350	350 x 250 x 350	507 x 250 x 457

Weight: Approx. 40 kg

IV.4.3 T100/x

Nominal voltage: See Table 1

Nominal current: See Table 1

Typical frequency range: 0–300 Hz

Typical 50Ω-insertion loss:

kHz	10	20	50	100	200	500	1000
dB	8	12	14	25	45	>60	>60

Connectors: B18N (multi-contact) or other on request

Dimensions in mm:

Whole filter (W x H x D):

T100/1	T100/5	T100/20	T100/100
357 x 1000 x 357	357 x 1000 x 357	357 x 1000 x 357	507 x 1000 x 457

Dimensions in mm:

Top box (W x H x D):

T100/1	T100/5	T100/20	T100/100
350 x 250 x 350	350 x 250 x 350	350 x 250 x 350	507 x 250 x 457

Weight: Approx. 46 or 58 kg

V π -Filters

V.1 Introduction

π -filters are for testing procedures with voltages up to 2 kV, whereas the T-filters are used for testing with higher voltages. Standard π -filters are available for three-phase and single-phase systems. Special filters for testing of two phases are available on request. π -filters are installed inline between voltage source and device under test. Their design follows a C-LR-C configuration.

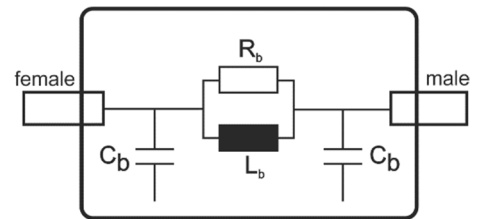


Figure V.1: Design of a single-phase π -filter

V.2 Installation

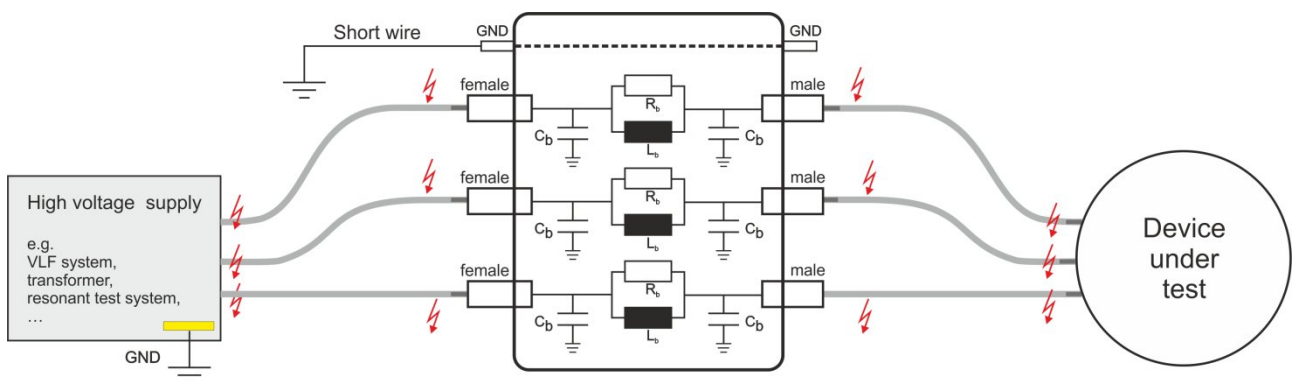


Figure V.2: Example test setup with 3Pi-filter

V.3 Operation

Every π -filter is marked with a plaque specifying the voltage and current that the filter can take. U_N stands for the nominal voltage, while I_{Ncont} specifies the maximum current with which the filter can be continuously operated. In order to prevent damage from heat, the filter must be switched off after that maximum period to cool down.

The following table shows voltage and current values for some of Power Diagnostix' π -filters.

Model	U_N	I_{Ncont}
1Pi1/60	1.0 kV	60 A
1Pi2/50	2.2 kV	50 A
2Pi1/100	1.0 kV	100 A
3Pi1/40	1.0 kV	40 A
3Pi1/60	1.0 kV	60 A
3Pi2/20	2.2 kV	20 A
3Pi2/50	2.2 kV	50 A

Table 2: Voltage and current values for π -filters

V.4 Technical data

V.4.1 All π -filters

Nominal voltage: See Table 2

Capacity: 1 μ F

Rated current: See Table 2

Typical frequency range: 0–300 Hz DC

Typical 50 Ω -insertion loss:	kHz	10	20	50	100	200	500	1000
	dB	8	12	14	25	45	>60	>60

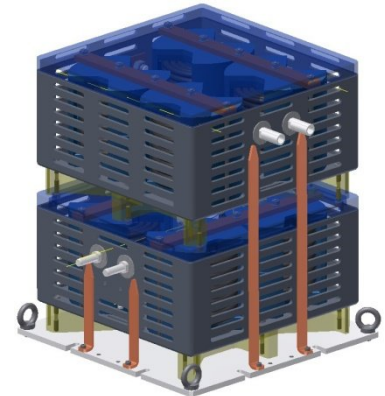
Dimensions and weight:

Model	Dimensions (H x W x D, excl. connectors)	Weight
1Pi-Filters	191 x 250 x 255 mm ³	Approx. 12 kg
3Pi-Filters	170 x 460 x 400 mm ³	Approx. 19 kg

VI Line filters

VI.1 Introduction

Power Diagnostix' single-phase line filters can reduce disturbance signals from the high voltage supply. This kind of filter is always used in combination with an additional blocking capacitor. As this combination results in a very low background noise it is often used for cable testing.



VI.2 Installation

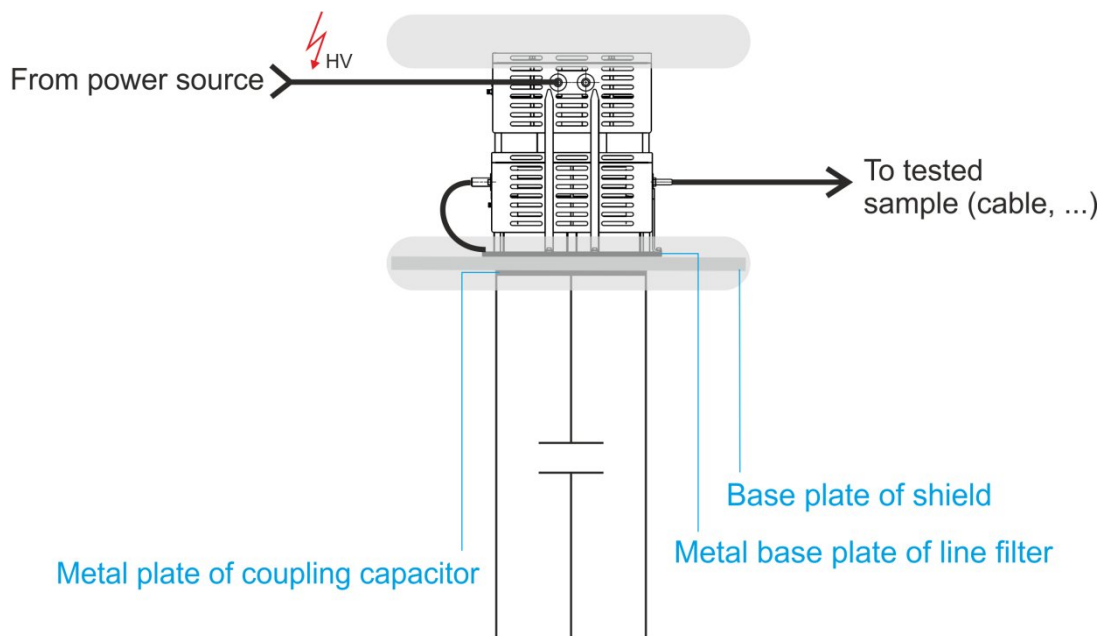


Figure VI.1: Setup of a line filter

VI.3 Technical data

VI.3.1 Line filter LF15

Input/output voltage:	500 V AC max.
Max. line current:	15 A AC
Connectors:	B18N (multi-contact)
Dimensions:	250 x 255 x 191 mm ³ (L x W x H)
Weight:	Approx. 15 kg

The filter has to be placed on an isolator or a blocking capacitor if used on higher voltages. The inductance is calculated for a 3 nF blocking cap.

VI.3.2 Line filter LF450

Input/output voltage:	Max. 500 V AC
Max. line current:	450 A AC
Connectors:	B18N (multi-contact)
Inductance:	Approx. 0.5 mH
Dimensions:	512 x 450 x 450 mm ³ (H x W x D, excl. connectors)
Weight:	Approx. 140 kg

The filter has to be placed on a blocking capacitor with an inductance ≥ 20 nF. The exact inductance value must be specified on order.



VII Ground filters

VII.1 Introduction

Partial discharge (PD) measurement requires a reasonable noise-free environment. Power Diagnostix' ground filters are designed to reduce high frequent disturbance signals from the ground leads. It can be used for HF separation of the test specimen from the ground potential of the power supply or other HV equipment within the environment without influencing the power frequency. The efficiency strongly depends on the general earthing within the laboratory. A split ground lead or copper band can be connected to the multi contact connectors or alternatively to the wing screws beside.



Figure VII.1: Ground filter GF50

VII.2 Installation

Please note, that grounding filters are not suitable for every kind of grounding. A correct position of the filter is very important, not alone for safety reasons, but as well for its performance. It is of utmost importance to select the correct grounding.



Warning:

Installing the ground filter introduces an inductance into the grounding system in order to avoid or block HF noise entering the measurement circuit through this grounding system. Adding an inductance into the grounding system can cause a transient rise of the ground potential. Hence, to avoid harming people in the test-bay, the ground filter must not be installed in a low impedance grounding providing the protective earth for measurement equipment, notebooks, and other equipment which could possibly be touched by members of staff or any other person in the test bay.

Never install the ground filter in the direct grounding of a coupling capacitor or quadrupole. It may worsen the background noise level.

Good positions for a ground filter are between the ground connection of the inverter control and the main grounding, the tank of a hi-pot to the main grounding or a transformer frame, or a tank to the main grounding.

The following diagram shows a possible test setup with a GF50.

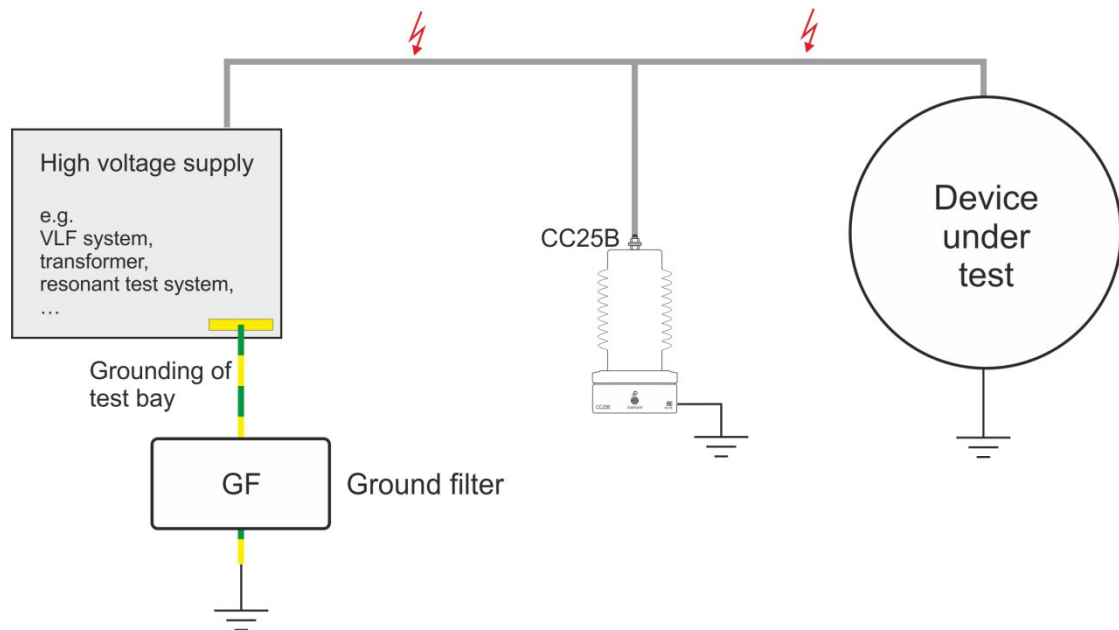


Figure VII.2: Connections of an example test setup with coupling capacitor and ground filter



Warning:

The GF50 must not be installed in a low impedance grounding providing the protective earth for measurement equipment that may be touched by humans in the test bay.

Please consider that grounding impedance will change due to higher inductance of grounding connection with ground filter interconnected. Please check if 400 μH inductance is within approved limits of your test bay!

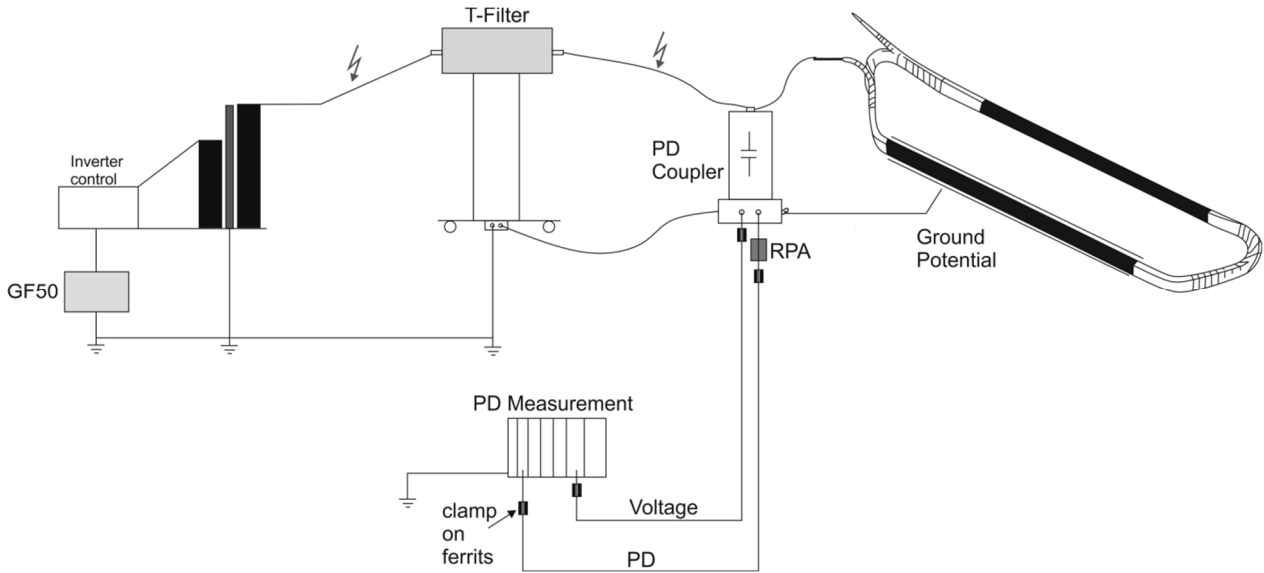
VII.3 Technical data

Max. current:	50 A
Inductance:	Approx. 400 μH
Input:	B18N (multi-contact)
Output:	B18N (multi-contact)
Ground connector:	M10, screw wing
Dimensions:	160 x 300 x 300 mm ³ (H x W x D, excl. connectors)
Weight:	Approx. 9 kg

VIII Appendix

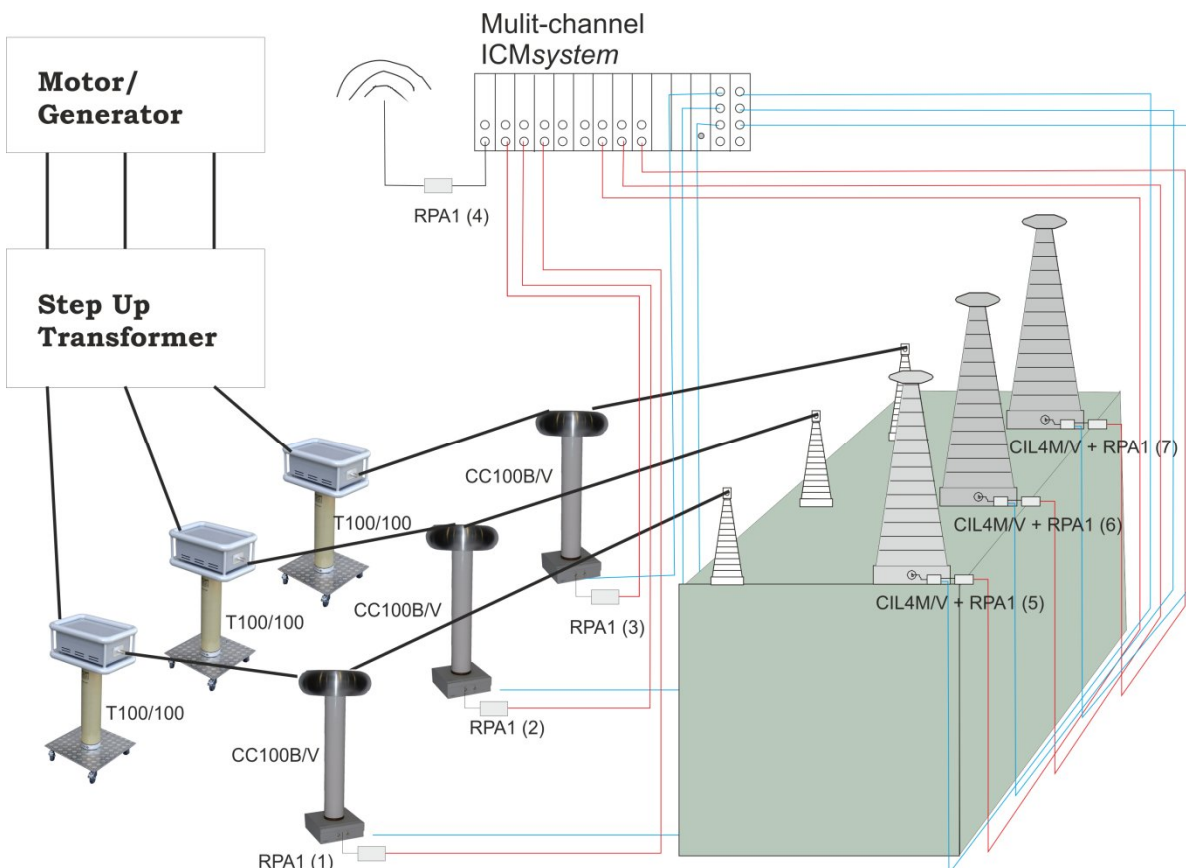
VIII.1 Setup examples

VIII.1.1 Testing of stator bars

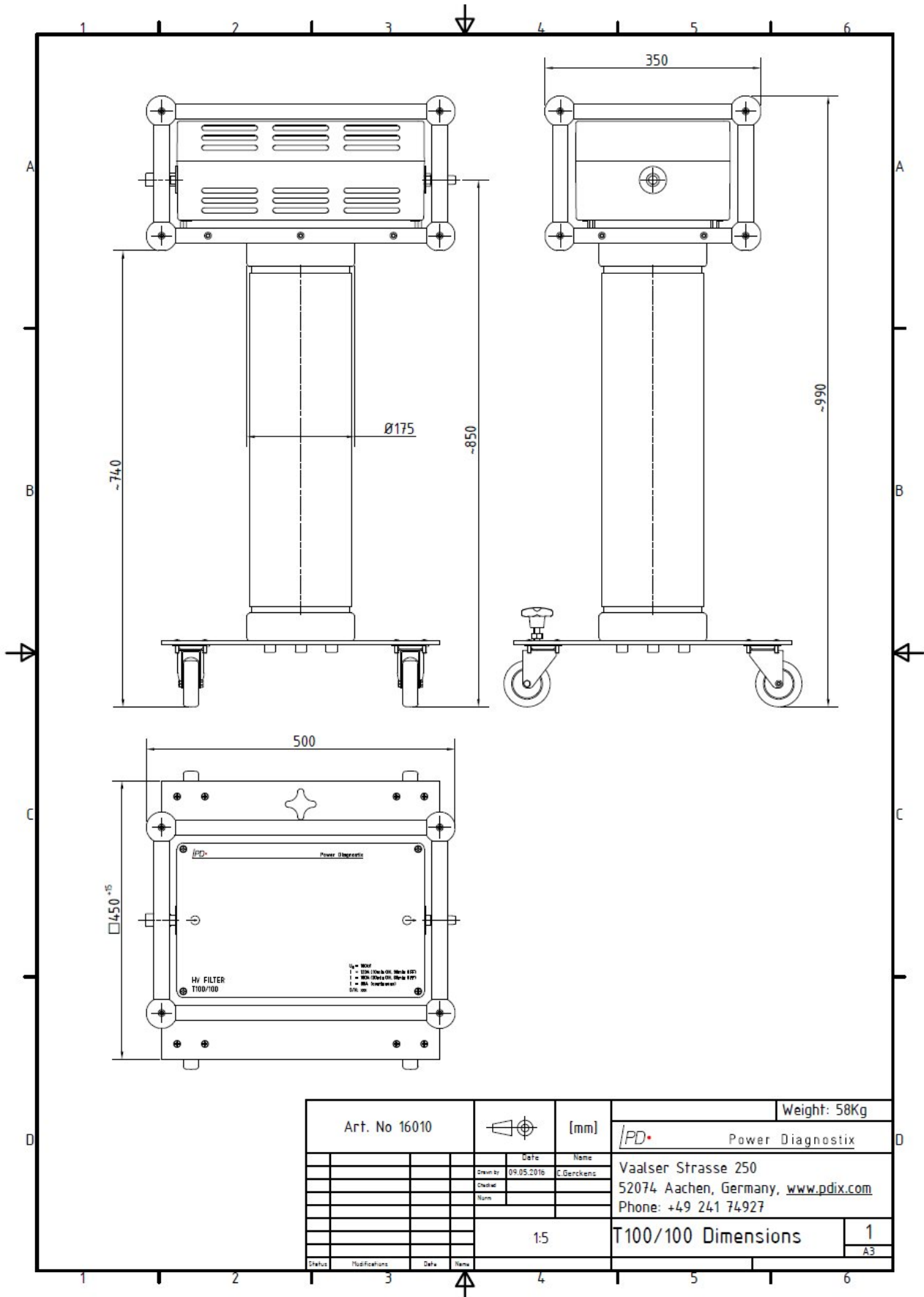


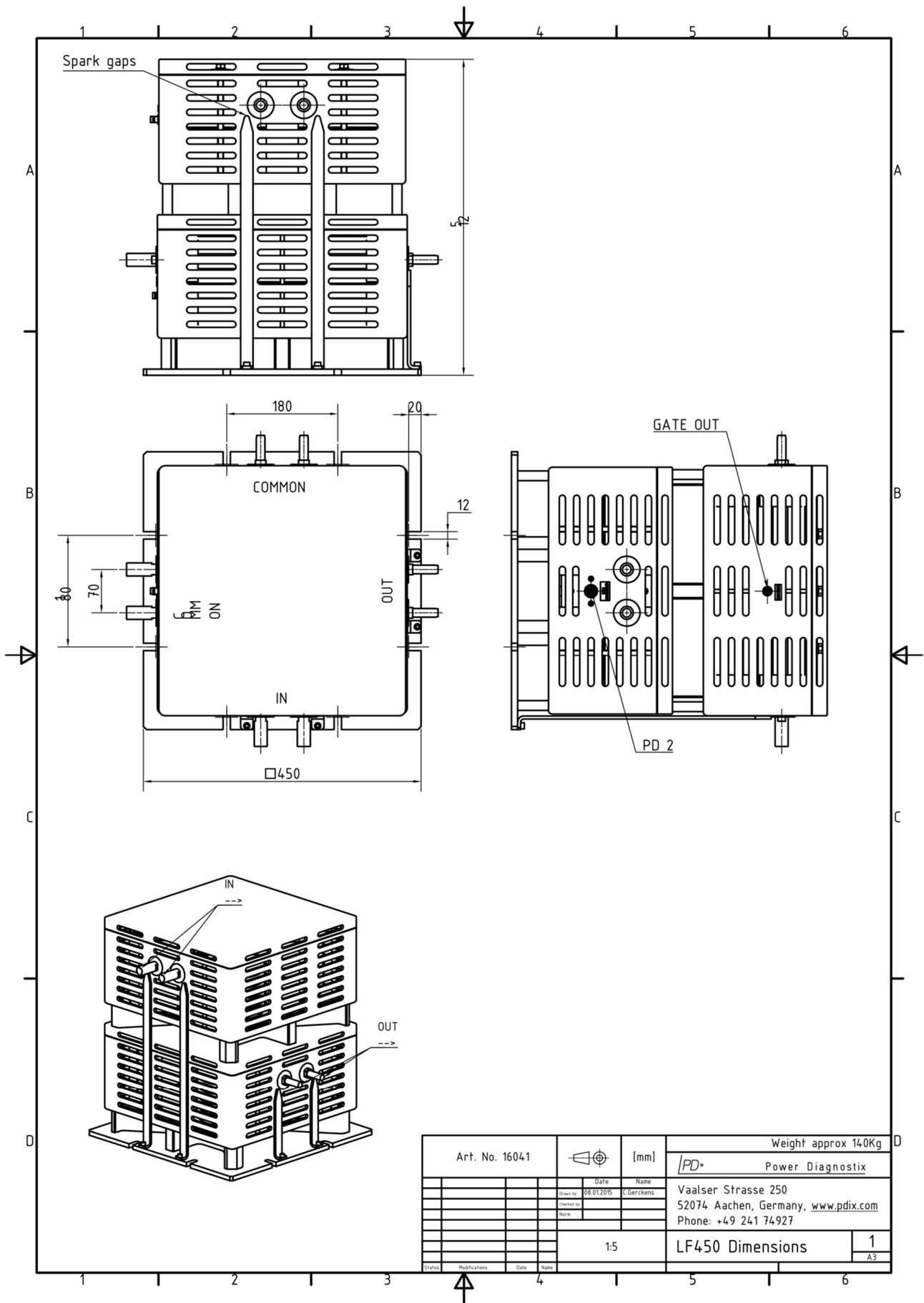
A test setup with the ground filter installed between the ground connection of the inverter control and the main grounding is safe for the personnel. Please note that with this setup disturbance signals from the main grounding are not filtered; only disturbance signals from the high voltage source are reduced.

VIII.1.2 Transformer testing



VIII.2 Technical drawings (examples)





Art. No. 16041		[mm]	Weight approx 140Kg
			PD+ Power Diagnostix
	Date	Name	Vaalser Strasse 250 52074 Aachen, Germany, www.pdix.com Phone: +49 241 74927
	Drawn by: 08.01.2015	C. Gerckens	
	Checked by:		
	Scale		
	1:5		LF450 Dimensions
			1
			A3