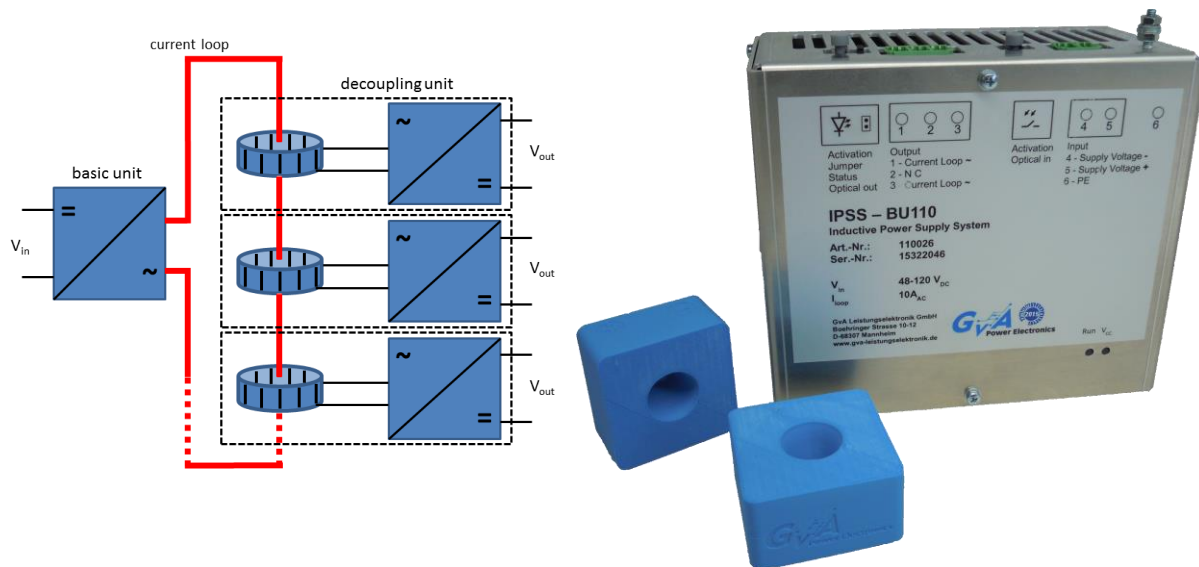


## Datasheet

### Inductive Power Supply System (IPSS)

- **Modular design**
- **Available in various output voltages**
- **High system voltage of 12kV<sub>AC</sub> between basic- and decoupling unit**
- **Large input voltage range: 24V<sub>DC</sub> up to 110V<sub>DC</sub>**
- **Various power supplies are substituted by one IPSS System**



#### General information:

The inductive power supply system (IPSS) is a power supply system which is able to provide several output voltages in applications where electrical power need to be supplied at different or at the same electrical voltage levels. The main areas of applications are those systems or devices which need to be supplied with power at different (high) voltage levels relative to earth and also isolated from each another.



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## 1 General Circuit Arrangements

### 1.1 Applications

Typical application areas for the IPSS are systems for electrical power supply and power transmission which use power semiconductors such as Thyristors or IGBTs for converting and controlling the electrical output power. Modern power semiconductors are nowadays capable of switching currents of several thousand amperes at voltages of several thousand volts. To ensure that they can be operated and monitored safely, power supplies are needed which are connected directly to the potential of the power semiconductors and need to be electrically isolated from the control and regulation systems of the plant.

Electrically isolated Inductive Power Supply System for:

- Driverboards e.g. for Thyristors or IGBTs, in particular in high-voltage applications or in the case of (multiple) series connection of power semiconductors or cascaded systems and voltage Multilevel Inverter Systems
- measurement and sensor systems (temperature, current, voltage sense)
- other electrical loads

at high-voltage potential.

### 1.2 Properties

The IPSS consists of 3 function blocks:

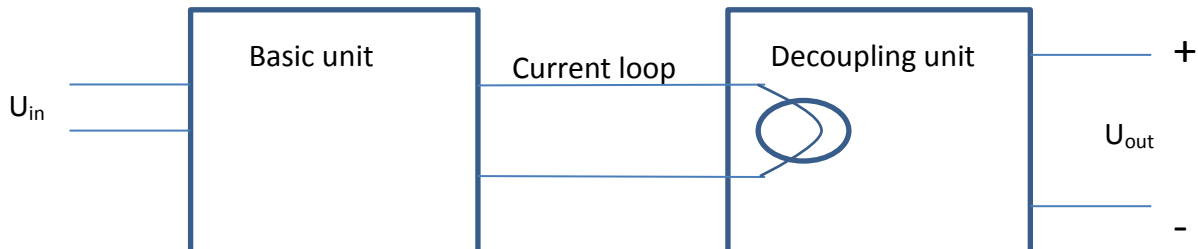


Figure 1: Block diagram of IPSS

In addition to the standard versions described in this document, customer specific versions are available.

### 1.3 The Basic Unit

The Basic Unit (**BU**) represents the primary side part of the system which is related to earth potential. The BU is supplied with DC voltage ( $20V_{DC}$  to  $70V_{DC}$ ) for BU48 or ( $50V_{DC}$  to  $125V_{DC}$ ) for BU110 and generates a trapezoidal alternating current with a frequency of 18 kHz. The amplitude of the alternating current and its frequency are largely independent of the supply voltage. The large range of the input voltage makes it possible to supply the BU from standard supply voltages ( $24V_{DC}$ ,  $48V_{DC}$ ,  $60V_{DC}$ ,  $110V_{DC}$ ). The required primary voltage level depends only on the number of decoupling units to be supplied and their output voltage. For a rough estimation the minimum input voltage can be calculated with the following formular:

$$U_{in\_min} = 15V + n * \frac{U_{out}}{8}$$

In Additional the total output power is limited by the maximum input current of the BU

$$\frac{15W + 1,2 * (n * U_{out} * I_{out})}{U_{in}} \leq I_{in\_max}$$

*n=numbers of decoupling units,  $U_{out}$ =Output voltage of decoupling unit*

The basic unit can be activated externally by a fiber optic receiver (light on = activated) or by a jumper (set by default)

The current loop is monitored. If the current is within the tolerance band the status LED shows the correct function of the loop. An additional optical fiber feedback is available as well.

### 1.4 The current loop

For standard applications, the current loop (**CL**) consists of a commercial single-wire line of appropriate cross section. In the standard version, the BU supplies an alternating current of approx.  $10A_{eff}$  and the line should therefore have a conductor cross section of at least  $1mm^2$ . If the IPSS is used in high voltages plants and the decoupling units are at high potential, particular attention must be paid to the insulation of the current loop conductors. The insulation levels and partial discharge strengths to be achieved are determined mainly by the quality of the insulation of the current loop conductor. The maximum length of the current loop is specified at 6 metres as standard and is therefore sufficient for most applications. In the case of longer lines the application has to be check individually.

A suitable High Voltage Cable for most applications is Silivolt-HV 2,5/9 by helektra.

### **1.5 The Decoupling Unit**

The decoupling unit (**DU**) uses a toroidal-core transformer in which the conductor of the current loop is passed through. The standard output voltages are  $12V_{DC}$ ,  $15V_{DC}$  and  $24V_{DC}$ . Special output voltages are available on request. The output voltage of the decoupling unit is controlled and is thus largely independent of the output current. The maximum output current of the decoupling unit is 650mA up to 850mA in the standard version. The maximum output current depends on the required output voltage. The output is short circuit proof and works as a current source in case of overload or short circuit.

The toroidal-core transformer of the decoupling unit represents an essential criterion determining the insulation resistance and the partial discharge strength of the system as a whole. To achieve the specified insulation characteristics the current loop has to be passed straight through the decoupling unit.

For the standard version of the IPSS, the maximum potential difference which can be permanently isolated by the materials of the current loop conductor and the size of the toroidal core of the decoupling unit is approximately  $12kV_{AC}$  (sinusoidal voltage with 50/60Hz). Up to this voltage, the system guarantees a power transmission that is free of any partial discharge. If further requirements in the level of the supply voltage or the permitted partial discharge levels are needed they have to be dimensioned in individual cases.

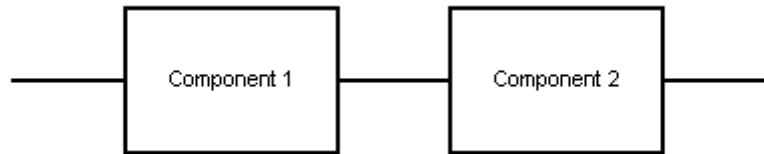
### **1.6 An overview of the advantages**

- Modular power supply for the electrically isolated operation of many individual loads with medium-frequency current loop feed and toroidal core decoupling unit.
- A basic unit replaces many individual high-isolating power supply units.
- Large input voltage range.
- Basic unit suitable for top-hat rail mounting (other designs available on request).
- System voltage of up to  $12kV_{eff}$  between (primary) low-voltage side and (secondary) load side and between the individual loads (higher voltages on request).
- The output voltage of the decoupling units can be chosen, as standard  $12V_{DC}$ ,  $15V_{DC}$  and  $24V_{DC}$  single output. Variants with other output voltages are available on request.
- Decoupling units with multiple outputs ( $+5V_{DC}$ ,  $\pm 12V_{DC}$ ) are possible as special versions.
- Different types of decoupling units can be used in the same current loop.
- Primary conductor made of highly flexible HV line allows lots of different mechanical design set-ups.

**1.7 Mean Time Between Failure (MTBF)**

The MTBF calculations are based on mathematical models for failure rates which are published in certain international standards.

Figure 2 shows a simple serial model of one basic-unit and one decoupling-unit.



**Figure 2:** Serial reliability Model

The MTBF value is calculated according the Siemens SN29500 Standard.

<b>Mean Time Between Failure MTBF</b> (@ T=25°C ambient temperature)	<b>IPSS [h] <sup>1)</sup></b>	<b>IPSS-BU [h]</b>	<b>IPSS-DU [h]</b>
	938.530	1.041.181	9.519.367

<sup>1)</sup> System of one Basic Unit (BU) with one Decoupling Unit (DU)

## 2 Technical data

### 2.1 Technical data IPSS-BU

Absolute maximum rated values			Min.	Typ.	Max.	
Input Voltage	BU48 BU110	$U_{in}$	-0,5 -0,5		75 125	V

Characteristic values			Min.	Typ.	Max.	
Input Voltage	BU48 BU110	$U_{in}$	20 40	48 110	70 125	V
Input current, stand-by $I_0$					20	mA
Input current, no load $I_L$	without decoupling units.				500	mA
Input current, full load $I_L$		$I_{in\_max}$			4000	mA
Input current, inrush	within 100ms after connection				800	mA
Output alternating current	depending on load		8	10	11	$A_{eff}$
Output frequency		$f_{out}$	17,9	18	18,1	kHz
Status Feedback	green LED OK: output voltage OK red LED low: voltage is below the desired output voltage (e.g overload)					

### 2.2 Technical data IPSS-DU

Characteristic values			Min.	Typ.	Max.	
Output voltage	DU-12 DU-15 DU-24	$U_{out}$	11,4 14,25 22,8	12 15 24	12,6 15,75 25,2	V
Output current	maximum current at $U_{out} = 12V$ $U_{out} = 15V$ $U_{out} = 24V$	$I_{out}$			850 800 650	mA
Output current	short circuit	$I_{sc}$	900	950	1000	mA

### 2.3 System data general

System data general				Min.	Typ.	Max.	
EMC robustness	According to 61800-3	power	$V_{burst}$		TBD		kV
		control	$V_{burst}$		TBD		kV
		aux	$V_{surge}$		TBD		kV
System voltage	Continuous Operation voltage between basic unit and output of decoupling unit, 50/60Hz sine				12		kV <sub>AC</sub>
Partial discharge inception voltage	Measurement with 50Hz sine, Silivolt-HV 2,5/9 Cable				15		kV <sub>AC</sub>
Partial discharge extinction voltage	Measurement with 50Hz sine, Silivolt-HV 2,5/9 Cable				13		kV <sub>AC</sub>
Storage temperature		$T_{storage}$	-40			80	°C
Operational ambient temp.		$T_{op\_amb}$	-20			40	°C
Humidity	no condensation					95	%
Protection degree	Basic unit				IP20		
Protection degree	Decoupling unit				IP00		
Level of efficiency	at full load			75			%
Weight	Basic unit				1050		g
Weight	Decoupling unit				108		g



### 3 Basic Unit: Mechanical drawing and connector interface

#### 3.1 Mechanical drawing Basic Unit

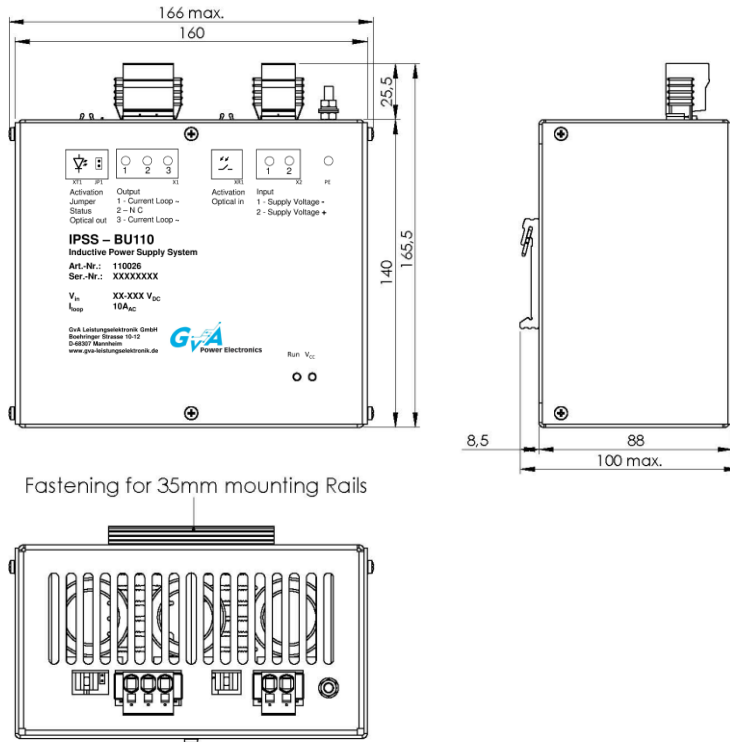


Figure 2: Mechanical drawing IPSS-BU

#### 3.2 Connector interface

Power Connectors	Connection	Comment	Connector
Input Voltage	Phoenix PC5 Serie Art. 1720466	1: - 2:+	Phoenix SPC 5 Serie Art. 1718481
Current Loopp	Phoenix PC5 Serie Art. 1720479	1: CL~ 2:NC 3: CL~	Phoenix SPC 5 Serie Art. 1718494
PE	M4 Stud		M4 Screw nut
<b>Signal Connectors</b>			
Fiber Optic enable	HFBR-2521	Activation: light on	HFBR4511/4513
Activation Jumper	2,54mm 2 pin Header	Activation: Jumper set	Standard 2 pin Jumper
Fiber Optic out Status out	HFBR-1521	Status OK: light on	HFBR4501/4503

### 3.3 3D view of Basic Unit

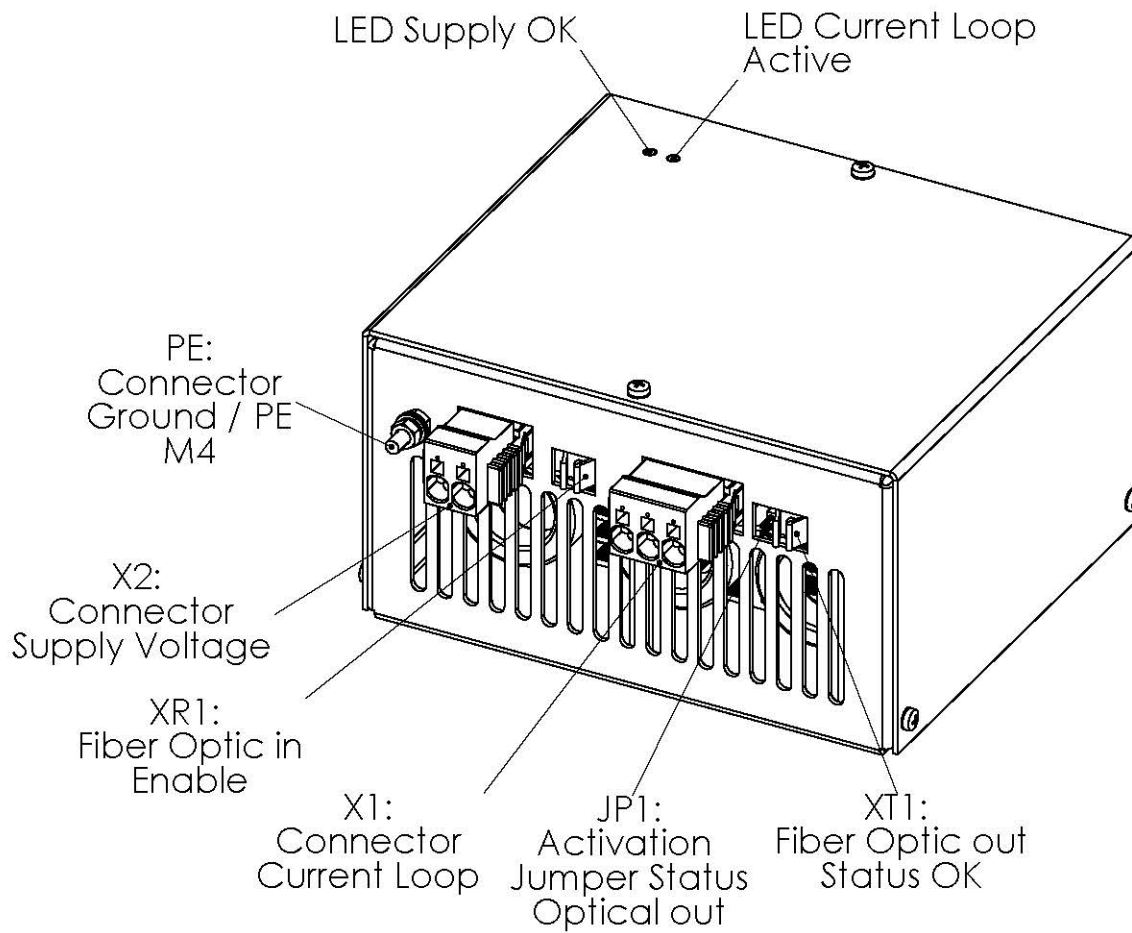


Figure 3: 3D view of IPSS-BU

**4 Decoupling Unit: Mechanical drawing and connector interface**

**4.1 Mechanical drawing Decoupling Unit**

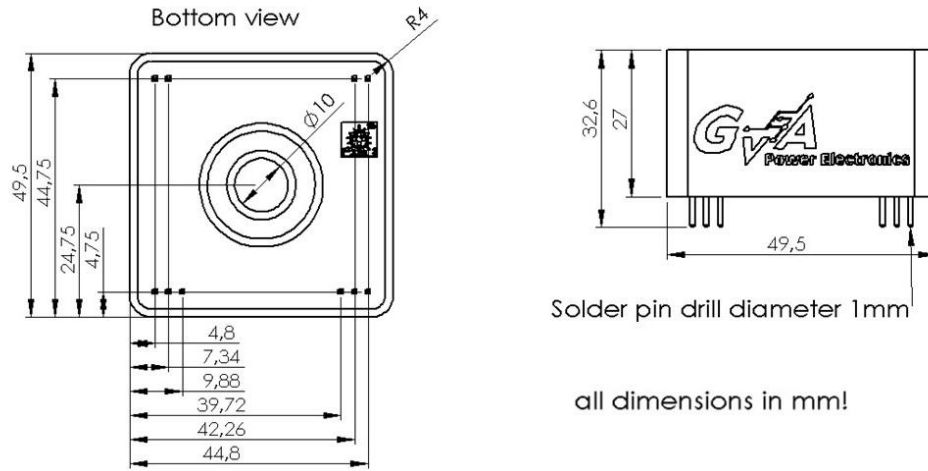


Figure 4: 2D view of IPSS-DU

**4.2 3D view of Decoupling Unit**

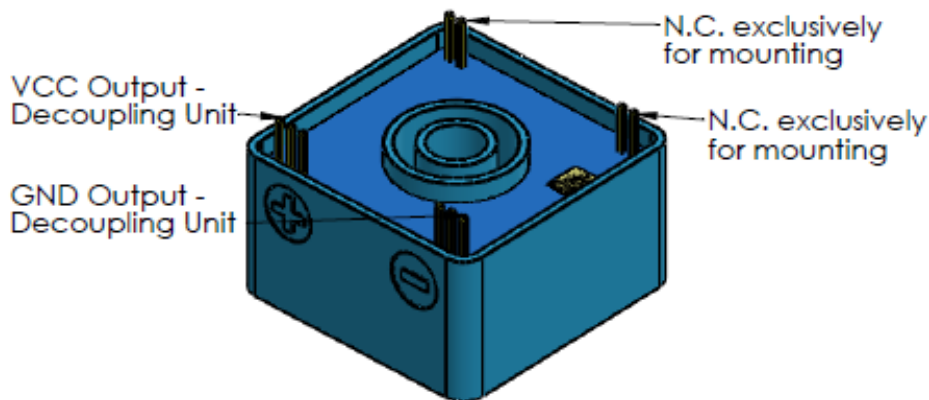


Figure 5: 3D view of IPSS-DU

**5 Document History**

<b>Name</b>	<b>Index</b>	<b>Date</b>	<b>Prepared</b>
DS_P15067	22	24.04.17	Bergold

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