

Description Primary Switched Power Supplies

Definition of the Output Data

CPAU, CPP with Programmable Output Voltage



Voltage Deviation in the Event of a Variation in Load (static)

Depending on the current load, there is a slight change in the voltage, the so-called control deviation, on all voltage regulators used.

It is specified in the data sheets as the maximum magnitude of a load variation of 0...100% of the nominal current. Measurement is conducted directly on the female connector with sense leads connected at the measuring point.

Voltage Deviation in the Event of a Variation in the Mains

If the mains is changed, the output voltage will also change slightly.

The data sheets specify the maximum control deviation of the output voltage on changing the mains between V_{INmin} and V_{INmax} .

Measurement is conducted directly on the female connector with sense leads connected at the measuring point.

Residual Ripple (100Hz - 100kHz)

A low high-frequency AC voltage share is superimposed on the output voltage. See fig. 1. This essentially results from the charging and discharging of the secondary energy storages with the switching frequency of the switching controller and from the charging and discharging of the primary energy storages with the double mains frequency. Additionally in the case of low output voltage or low output current a heterodyning frequency caused by the controller can result. The value specified in the data sheet is the peak-peak value V_{RPP} .

Voltage Rise/Drop when Programming

If the programmed set value is suddenly changed the controller can not adapt the output voltage as fast as desired to the new set value. The output voltage can only be changed with a limited speed. This alteration speed is stated in the data sheet.

Measurements are taken directly on the connector strip with sense leads connected to the point of measurement.

Superimposed Switching Spikes

Fast current and voltage variations occur when the power transistors are switched on and off. This results in high-frequency transient impulses superimposed on the output voltage of the power supply.

These switching spikes are poor in energy.

The data sheet values are measured directly on the female connector without sense leads with a bandwidth of 20MHz.

They are peak to peak values V_{SPP} as shown in figure 1.

Dynamic Voltage Deviation and Regulation Time

Voltage overshoot and undershoot occur in case of abrupt load variations. See figure 2.

Causes of the voltage deviation (ΔV) are the energy stored in the output circuit and the limited speed of the controller. The regulation time (Δt) is defined as the time until the output voltage returns to remain within a tolerance band after a load variation. The tolerance band is defined as $\pm 20mV$. The voltage and current characteristics as a function of time are shown in figure 2.

Values are measured directly on the female connector with sense leads connected at the measuring point.

Fig. 1
Output voltage

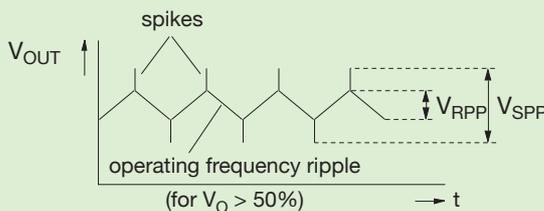
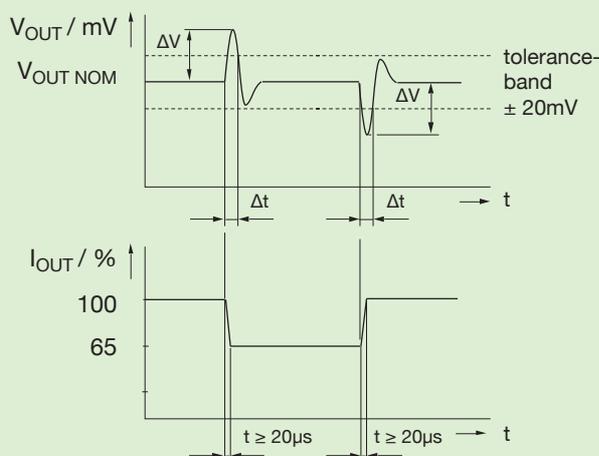


Fig. 2
Voltage variation of the output when subject to a defined sudden load variation



Description Primary Switched Power Supplies

Applications

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Connection of the Load

Load lines and sense leads should be laid to the load twisted or screened.

Load lines

It is recommended that the load line is terminated on the load with a ceramic capacitor even if no sense leads are connected.

Sense leads

The power supplies are generally ready to operate even if sense leads are not connected.

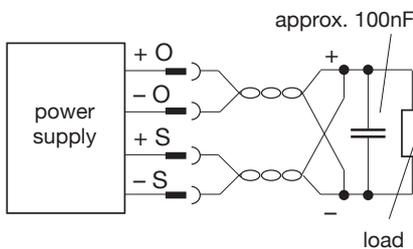
External bridges do not have to be wired.

In many practical applications, the devices are operated without sense leads being connected. E.g. in the case of short (low impedance) load lines or low load alternation.

The actual value of the voltage is measured directly at the load through the sense leads. Voltage drops through connectors and load lines are automatically compensated by the electronic regulation circuit. The stabilisation is designed for the value specified in the data sheet per load line.

To this end no changes are to be made to the power supply itself. Only the sense leads are externally connected to the load lines directly at the load.

The load lines may not be disconnected before the sense leads, or the sense leads may not be connected before the load lines, as this will lead to the destruction of the device.



Automatic Mains Switchover (CPAU)

Devices of the CPAU series switch automatically to 115Vac or 230Vac input voltage.

Note

If the mains voltage is changed from 115Vac to 230Vac the change-over takes place automatically. If the mains voltage drops from 230Vac to 115Vac the device remains in the 230Vac range due to safety reasons. In order to reactivate the 115Vac range the device has to be switched off first.

The power supply may not be operated outside the defined mains input voltage ranges.

Changing the Mains Input Voltage (CPP)

By devices of the CPP series no change of the mains input voltage is supported. The mains input voltage must be given with the order of the devices.

Input Transient Protection

A varistor between L1 and N suppresses the transients which can result when switching inductive circuits.

Starting Inrush Current

To limit the inrush current, the equipment features a NTC resistor in the input circuit. On reaching the operating temperature, the resistor has a low impedance and this means worst case conditions when switching on the equipment again immediately after switching it off.

The current surge is described through the current integral (see technical data: "unit cold" and "worst case").

The size of the maximal inrush current is limited by the internal resistance of the equipment, the lead resistance and the impedance of the main.

Definition

To measure the inrush current, a network simulation is used with 0.5Ω ($0.4\Omega + j0.25\Omega$). The lead-in has a length of 1m and a line diameter of 2.5mm^2 .

Note

So that the inrush current indicated in the data sheet ("unit cold") is not exceeded, the power supply has to remain switched off at an ambient temperature of $\leq 25^\circ\text{C}$ for approx. 5 minutes.

Extern ON/OFF

The units can be switched on and off with an external control voltage.

It is not possible to use the output voltage of the power supply to switch itself off. The power supply can not deliver an output voltage of min. 4V, while it is switched off.

Voltage levels at the Extern ON/OFF Input

Unit ON $\leq 0,6\text{V}$ or not connected

Unit OFF $\geq 4\text{V}$ to max. 30V

$V_{I/O} = 5\text{V}$ $I_{I/O} \leq 2\text{mA}$

$V_{I/O} = 30\text{V}$ $I_{I/O} \leq 10\text{mA}$

Any DC voltage (SELV) referred to – output of outout 1 can be used as the signal voltage.

Parallel Connection

A connection in parallel is not suggested.

Electrical Isolation

On Kniel primary switched power supplies, all inputs and outputs are electrically isolated. This means that the outputs can be freely interconnected. (Pay attention to the breach of security!)

Description Primary Switched Power Supplies

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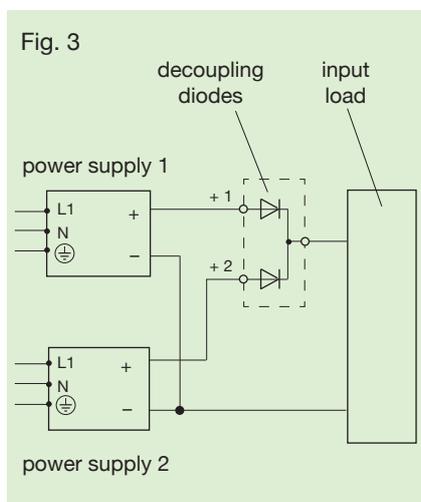


Redundancy Operation

In order to increase the operational safety of the system the units can be switched to redundancy operation. See figure 3.

In the case of redundancy operation, the unit outputs must be decoupled by diodes.

In this operating mode, sense lead operation is impossible.



Voltage Programming with External Voltage

In this operating mode the output voltage must be programmed with an external programming voltage from 0V to 10V or 0V to 5V depending on the device model (see the product number). See figure 4.

The output voltage is proportional to the programming voltage:

E. g. at 0V - 10V :

$$V_{set} = 0V ; V_{OUT} = 0\% \text{ of } V_{OUT\ max}$$

$$V_{set} = 5V ; V_{OUT} = 50\% \text{ of } V_{OUT\ max}$$

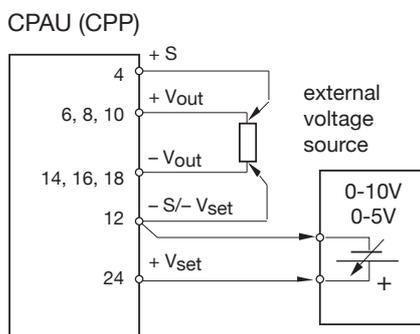
$$V_{set} = 10V ; V_{OUT} = 100\% \text{ of } V_{OUT\ max}$$

The programming input has an internal resistor of approx. 10kΩ at 0V to 10V and 5kΩ at 0V to 5V programming voltage.

Tolerance calibration:

Under maximum programming voltage the user sets the desired output voltage on the potentiometer at the front of the device. The rated output voltage can be set with the device potentiometer from 100% to 50% of its maximum value.

Fig. 4 Connection diagram Voltage programming



Caution:

When increasing the output voltage above the rated device voltage, either by turning the potentiometer on the front side of the device further clockwise or by exceeding the maximum programming voltage the output data is no longer guaranteed, the overvoltage protection can trigger and the device may switch off.

If the programming inputs are not connected a residual voltage of approx. 1V can be present at the output.

Voltage Programming with External Resistor

In this operating mode the output voltage is set through a potentiometer. To this end the device supplies an internal auxiliary voltage ($V_{aux} = 5V$) related to -S through an internal protective resistor of 2.74kΩ. This programming auxiliary voltage is connected to a 10kΩ potentiometer through a 1.5kΩ dropping resistor. See figure 5.

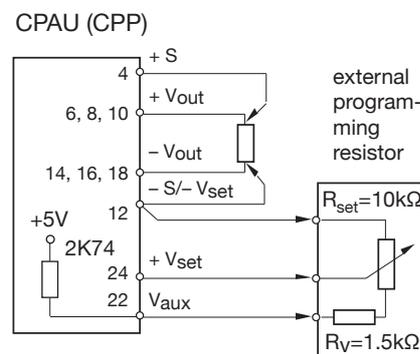
$$R_{set} = 0\Omega ; V_{OUT} = 0\% \text{ of } V_{OUT\ max}$$

$$R_{set} = 10k\Omega ; V_{OUT} = 100\% \text{ of } V_{OUT\ max}$$

Tolerance calibration:

The user sets the desired output voltage on the potentiometer at the front of the device with the external potentiometer set to maximum (10kΩ). The rated output voltage can be set from 100% to 50% of its maximum value using the device potentiometer.

Fig. 5 Connection diagram Resistor programming



Calculation examples for the resistor programming on request.

Caution

When increasing the output voltage above the rated device voltage, either by turning the potentiometer on the front side of the device further clockwise or by incorrectly selecting the dropping resistor of the potentiometer, the output data is no longer guaranteed, the overvoltage protection can trigger and the device may switch off.

To operate the power supply a resistor must be connected to the programming input. If the programming inputs are not connected a residual voltage of approx. 1V can be present at the output.

Please note (Voltage programming)

For output voltages lower than 0.5 x $V_{OUT\ max}$ the devices partially operate in the audible frequency range.

Description Primary Switched Power Supplies

Applications



CPAU, CPP with Programmable Output Voltage

Setting the Type of Programming

The article-number determind the type of programming as delivered condition.

To change the type of programming, you have to change the jumper as described below.

Designation of the internal device plug-in bridges	JU	J10V	J5V
with voltage 0 - 10V	X	X	
with voltage 0 - 5V	X		X
with resistor (potentiometer 10kΩ + R _V 1.5kΩ)		X	X

1. Disconnect the device from the mains.
2. Push the bottom cover plate towards the plug.
3. Reconnect the jumper behind the front-panel near the earth connection, according to the programming desired.

Discharging Circuit

To discharge the output circuit in a short time when programming the output voltage to a lower value (even with no output current), the power supplies of this series has a discharging circuit integrated.



This circuit will be damaged, if electrical energy is feed into the output circuit.

Current Limitation

Kniel primary switched power supplies are protected against overload by a built-in current limitation circuit and are continuous short circuit proof.

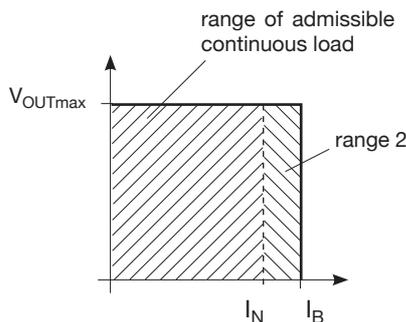
The current limitation is factory set to the value specified in the data sheet. If this value is exceeded the output current is limited to the maximal value and the voltage is reduced according to the dimension of the overload.

The unit automatically returns to voltage control after the fault has been eliminated.

Note

For output voltages lower than 0.5 x V_{OUTmax} the devices partially operate in the audible frequency range.

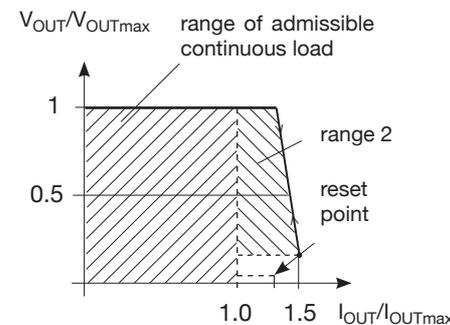
Characteristic Curve CPAU



I_N = nominal current
I_B = current limiting

Range 2 = admissible range of overload. Time response overload to continuous load max. 30%.

Characteristic Curve CPP



Range 2 = admissible range of overload. Time response overload to continuous load max. 30%.

Up to the reset point, the VI characteristic curve moves on to the continuous lines. If the reset point is exceeded, the current control follows the dotted characteristic line.

The reset point is at approx. 20% of V_{OUTmax} and approx. 150% of I_{OUTmax}.

Temperature Coefficient

The temperature coefficient indicates the maximum relative change of the output voltage per Kelvin of temperature change.

Thermal Switch-off

In order to protect the power supply from thermal overload each device is equipped with a thermal monitoring circuit. If the device overheats when the cooling is insufficient it switches itself off. After cooling down the power supply switches itself on again automatically.

Overvoltage Protection (output)

The overvoltage protection feature (OVP) integrated as standard protects the connected electronic circuitry against inadmissibly high voltages. If an internal or external overvoltage occurs at the output of the power supply, a thyristor fires and shorts the output. At the same time, the power supply is switched off. The residual voltage of the output is zero after switch-off of the primary switched power supply. In the case of external faults, the power supply can be placed back into operation by switching the input voltage off for approx. 1 minute, after the external fault has been remedied.

Description Primary Switched Power Supplies

Mechanic, Environmental, Safety

CPAU, CPP with Programmable Output Voltage



Mechanical System

Kniel primary switched power supplies are compact, fully plug-in power supplies. They have been designed specifically for use in subracks according to IEC 60297-3-101 (19" standard).

The rugged mechanical structure consists of aluminum.

Specifically developed press-drawn sections for heat sinks and side walls form the basis for the finely tuned system between mechanical strength, protection against electromagnetic interference and optimum heat dissipation. The front panel projects beyond the body by approx. 1/2 HP at the right and left. This produces an air slot to the neighboring module in the subrack, ensuring adequate convection cooling up to + 70°C ambient temperature. This prevents mutual heating.

Degree of protection:
IP 30 according to
EN 60529/IEC 529
when fitted, at the front

Mechanical load rating:

Vibration:
0.15mm double amplitude
or 2g at 5 - 500Hz
according to DIN 40046
(same values in transportation
packaging)

Shock:

10g; duration 11ms
according to DIN 40046
in transportation packaging
10g, duration 18ms.

Environmental

Operating temperature range:
see data sheet.

Storage temperature:
see data sheet.

Humidity: 95% ,
without condensation.

Safety

RoHS

EU Directive 2011/65/EU

The reduction of hazardous substances in electrical and electronic equipment is an important contribution to the protection of the environment and deserves the strongest possible support from all of us.

All Kniel products/power supplies delivered after 15 January 2006 comply with EU Directive 2011/65/EU except for some customer specific products. Products not compliant with said directive are noted as such in the delivery documents.

WEEE

EU Directive 2012/19/EU

Directive 2012/19/EU particularly applies to short-lived consumer goods for the mass market. Kniel products are generally used as capital goods over periods of many years or even decades. Therefore our products do not belong to the intended target group of the directive. Additionally said directive focusses on complete units or systems and thus does not cover our products. None of our products can be classified into one of the categories mentioned in said directive. Hence, Kniel does not plan to provide statistical information about when our products were placed on the market. We do not offer cost-free return of our products.

Description Primary Switched Power Supplies

Safety



CPAU, CPP with Programmable Output Voltage

Electrical Safety



Kniel primary switched power supplies are designed to cover a broad range of applications. The power supplies are being built according to **EN 60950 / IEC 950** for safety of data processing equipment, including electrical office machines, in order that the conventional regulations applicable to different fields of application are observed.

Important Electrical Safety Features

All output circuits are electrically isolated, both with respect to each other and with respect to the input circuit. Electrical isolation between primary and secondary circuits by adequate clearances and creepage distances. Every unit is subject to a high-voltage test to ensure that safe electrical isolation is actually provided.

Test voltages (proof voltages):

primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	700 Vdc

Note

On no account do we recommend a repeat test by the customer according to EN 60950/IEC 950 since this could damage semiconductors and insulation. If a further high-voltage test on each unit is mandatory, the test conditions must be coordinated with Kniel. Otherwise, we are unable to accept warranty.

SELV

Kniel power supplies with an output voltage of max. 55Vdc keeps to the requirements of SELV circuits. SELV circuits need a surely electric isolation to the mains.

Definition of the Ambient Conditions According to EN 60950/IEC 950

Pollution Severity II

Only non-conductive pollution occurs. Temporary conductivity as the result of condensation must be anticipated occasionally.

Overvoltage Category II

Equipment of overvoltage category II is intended for use in installations or parts thereof in which lightning overvoltage does not need to be taken into consideration. This includes, for instance, domestic electrical appliances. Overvoltages resulting from switching operations must be taken into consideration.

Definition of the Safety Class

Kniel primary switched power supplies are constructed according to safety class I. With this safety class, all exposed parts must be connected to the PE wire with low resistance. Each unit is tested before delivery.

Leakage Current

The maximum permitted leakage current of permanently installed equipment is 3.5mA. Kniel power supplies of this series do not exceed this value between 45 and 66Hz frequency of the mains. Between 45 and 66Hz frequency of the mains, they meet the limits for hand-held equipment of $\leq 750\mu\text{A}$.

More Tests

A fire resistance test, an overload test and a test of mechanical load capability are also conducted according to EN 60950/IEC 950.

A test designated "operation not as intended and incorrect operation" is conducted in order to allow us to assess the risks and dangers if the unit is operated not as intended.

Description Primary Switched Power Supplies

EMC

CPAU, CPP with Programmable Output Voltage

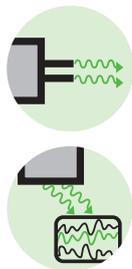


EMC

The switched mode power supplies fully meet the legal requirements for emitted interference according to EN 55022/55011 as well as the interference immunity according to EN/IEC 61000-6-2.

To fully serve this wide application area the regulations for the domestic and commercial sectors apply for emitted interference, and the regulations for the industrial sector apply for the interference immunity. This means in each case, that a more stringent limit value is valid.

Emitted Interference According to EN 55022/55011 (emission)



In primary switched power supplies radiated noise is generated by high-frequency, periodic switching operations.

The higher the switching frequencies and the steeper the rising or falling edges of current and voltage are, the higher will be the high-frequency share of the noise spectrum. The noise spectrum is considered on a bandwidth of 150KHz to 1 000MHz.

Up to 30Mhz the interference voltage is measured and evaluated on lines. Either as a average measurement^{*1} or as a quasi-peak measurement^{*2}.

In the higher frequency range of 30MHz to 1 000MHz the interference fields emitted in 10m distance are recorded. The permissible limit values are intended to prevent interference to neighboring electronic equipment.

Corresponding limit values are laid down in EN 55022.

If the primary switched power supplies are used in residential and commercial buildings the limit curve B must be upheld.

See fig. 6 and fig. 7.

The limiting values for industrial applications are defined in EN 55011.

Fig. 6
Limit value class
150KHz to 30MHz

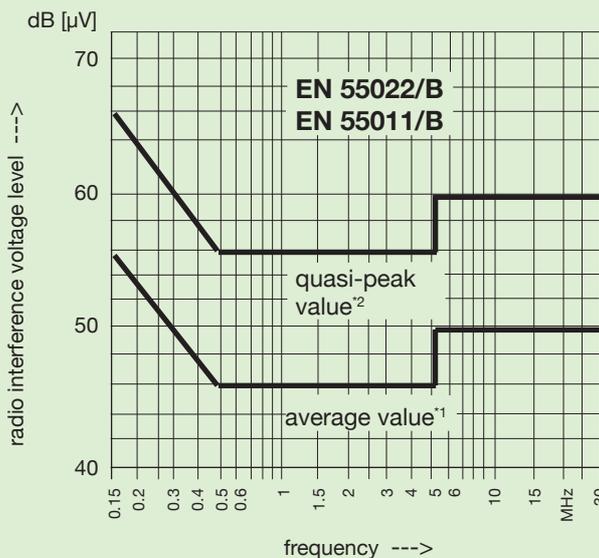
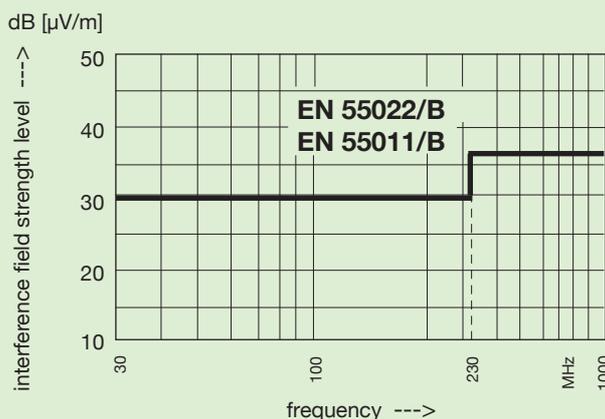


Fig. 7
Limit value class
30MHz to 1 000MHz



*1 = The average value is the arithmetic mean value of a signal.

*2 = In the case of a quasi-peak measurement, the peak value of noise voltage is evaluated in conjunction with the pulse frequency.

Description Primary Switched Power Supplies

EMC

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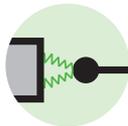


Interference Immunity According to EN/IEC 61000-6-2

The immunity to electromagnetic interference, as occurs in practice as the result of static discharges, switching operations on inductive circuits and capacitors, as the result of lightning strike and as the result of high-frequency irradiation is verified by a series of tests.

The limit values according to EN/IEC 61000-6-2 (industrial application) apply for Kniel primary switched power supplies.

ESD - Immunity to Electrostatic Discharge According to EN/IEC 61000-4-2



This test verifies the immunity to electrostatic discharge as may occur from the operator's body when touching the equipment. Static discharges as can arise between different objects are also covered with this test.

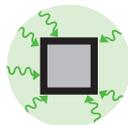
The required test voltage (proof voltage) is:

- 8kV - discharge in air
- 4kV - contact discharge.

Evaluation criterion B.

Kniel primary switched power supplies meet evaluation criterion A.

Immunity to Electromagnetic Fields According to EN/IEC 61000-4-3



Electromagnetic fields are generated by radio-telephony equipment, radio broadcasting stations, TV stations and other industrial electromagnetic interference sources. The aim of this standard is to ensure immunity of equipment. The test covers the frequency band from 80MHz to 1 000MHz with a field strength of 10V/m.

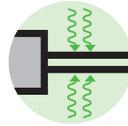
The measurement is carried out in a booth.

No limit values or maximum permissible deviations are stipulated in the standard.

Our test criterion is:

During this test, the output voltage may not deviate more than 2% from the set value.

Fast Electrical Transients Burst Test According to EN/IEC 61000-4-4



Fast transient bursts occur during switching operations, e.g. disconnecting inductive loads and bounce of relay contacts, in all electrical power supply systems.

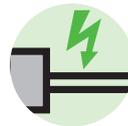
The burst test is intended to guarantee that the function of electrical equipment is not impaired on a sustained basis as the result of these extremely brief voltage peaks.

The standard demands:

Evaluation criterion B.

Kniel primary switched power supplies meet evaluation criterion A.

Immunity to Surge Voltages According to EN/IEC 61000-4-5



This type of surge voltage occurs in supply systems as the result of switching large inductive circuits or capacitor banks, as the result of short-circuits in the system or as the result of lightning strike.

The standard demands:

- 2kV L1 / N (+/-) --> SL
- 1kV L1 (+) --> N (-).

Evaluation criterion B is met.

Immunity to Conducted Interference Induced by High-Frequency Fields According to EN/IEC 61000-4-6



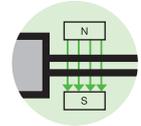
In the frequency band 150kHz to 80MHz, the equipment is subject to modulated fields which induce noise voltages of 10V in the supply lead.

No limit values or maximum permissible deviations are stipulated in the standard.

Our test criterion is:

During this test, the output voltage may not deviate more than 2% from the set value.

Magnetic Field with Energy Frequency According to EN/IEC 61000-4-8



In the frequency range between 50Hz and 60Hz the device is applied with 30A/m. There must be no interference. Kniel primary switched power supplies meet evaluation criterion A.

Collapse of Voltage and/or Voltage Interruptions According to EN/IEC 61000-4-11



The requirements demanded by EN/IEC 61000-4-11 for collapse of voltage and/or voltage interruptions are fully met.

Note

Compliance with the specified standards applies only to the Kniel power supplies.

If the power supply is integrated in an overall system, it is the user's obligation that the complete system meets the applicable standards.

Kniel is unable to assume warranty for this owing to the wide variety of applications.

Please consult Kniel regarding test conditions if the interference immunity tests are to be repeated.

Explanation Evaluation criterion

A : In this test the function may not be influenced in any way.

B : Partial loss of power or function. After completing the test the unit must operate within its specification again.