

Description Primary Switched Power Supplies

Definition of the Output Data

CP, CPD, CPM, CPQ, FP, FPD, FPM, FPQ, CPW, CPWD, CPWM



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 varied, the output voltage will also vary 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)

When rectifying the 50Hz AC voltage, a 100Hz superimposition on the DC voltage results.

This 100Hz ripple is measurable as a residual ripple on the output voltage.

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

Operating Frequency Ripple

The output voltage of primary switched power supplies is characterised by a small superimposed AC voltage component, the operating frequency ripple. See figure 1.

This results from charging and discharging of the secondary energy stores with the switching frequency of the power supply.

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

The value in the data sheet is the peak to peak value V_{RPP} as shown in fig. 1.

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 fig. 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

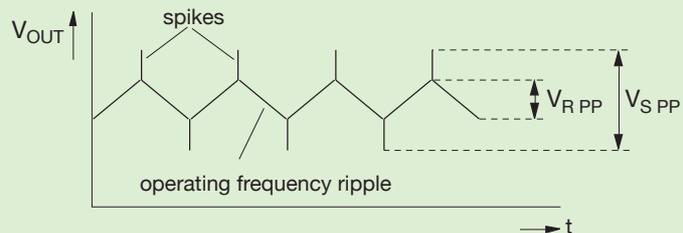
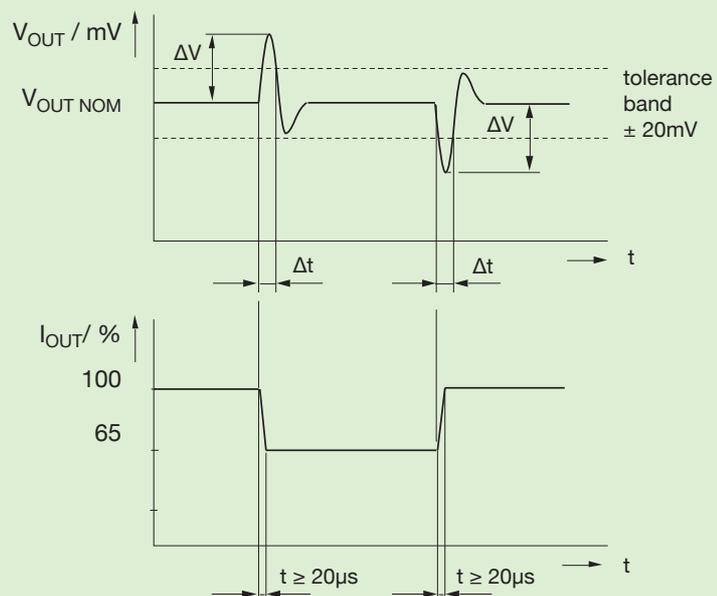


Fig. 2
Voltage variation of the output when subject to a defined sudden load variation



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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.

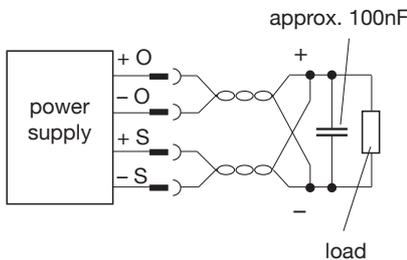
External bridges do not have to be wired.

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.



Changes in the Mains Input Voltage

If a unit's input voltage is given as 115Vac/230Vac in the data sheet, the factory setting can be changed from 230Vac to 115Vac by rearranging the respective jumpers.

Before any rearranging the power supply has to be disconnected from the mains.

Refer to the instructions given on the unit.

Power supplies with an input voltage range of 100 to 240Vac, can be operated without adjustment to 230Vac or 115Vac.

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.

Electronic Base Load

The multiple voltage units are equipped with an electronic base load as standard. This ensures that even if the main output of the power supply is unloaded, the other outputs still can deliver their nominal power.

If the main output is loaded again, the base load switches off continuously so that the full output power of the unit is available for the load.

For continuous operation however main output should be loaded with at least 5W.

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
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Unit OFF	$\geq 4\text{V}$ to max. 30V
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$V_{I/O} = 5\text{V}$	$I_{I/O} \leq 2\text{mA}$
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$V_{I/O} = 30\text{V}$	$I_{I/O} \leq 10\text{mA}$
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Any DC-voltage (SELV) referred to - output of outout 1, can be used as the signal voltage.

Power Distribution

For multiple voltage units, the output power specified can be divided between the outputs as required within the maximal currents specified in the data sheet.

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Parallel Connection (single voltage)

Units with a PA pin can be connected in parallel. Up to three units of the same type may be operated in parallel to increase the output power. Their individual PA-contacts have to be interconnected so that in the event of a fault the overvoltage protection circuit integrated in one of the units also switches off the paralleled power supplies.

The load lines + and - should be interconnected in a balanced manner as possible. The sense leads should not be used.

For units with double pin assignment "Ext. On/Off / PA":

When units of this kind are connected in parallel the Extern ON/OFF control voltage has to be decoupled by a diode so that the PA connection does not become ineffective.

A connection in parallel is not suggested for multiple voltage units.

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!)

Power Boost

The full output current of our units is available in ambient temperatures between -25°C and $+70^{\circ}\text{C}$ without derating. Additionally our units deliver even 20% more output power for a short time of peak loads. This is the power boost function.

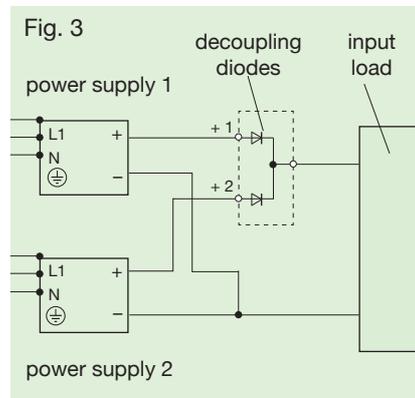
The power boost can also be used as continuous power in ambient temperatures up to 45°C .

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. Existing PA-contacts may not be interconnected.



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 in accordance with the dimension of the overload.

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

Also see thermal switch-off.

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 with an appropriate note in the data sheet 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 primary switched power supply is switched off. The residual voltage of the output is zero after switch-off of the 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.

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PFS - Power-Fail Signal

The PFS should always be activated if the power supply at the input of the load is at risk.

As a result emergency routines can be started in good time if a control or computer unit fails and thus errors can be avoided. See figures 5 and 7.

The monitoring relates to the input and output voltage.

See description $PFS = f(V_{IN})$ and $PFS = f(V_{OUT})$.

The power-fail signal is available potential free as an optocoupler-signal and can thus be freely connected.

(Pay attention to the breach of security! The spacing between optocoupler and output voltage is 0.5mm.)

1. $PFS = f(V_{IN})$

- Brief mains voltage fades are bridged and no fault alarm is generated. Bridging time = t_B .
- If the input voltage remains below the response threshold for a time period longer than the "bridging time", the PFS is activated.
- After the PFS is triggered, the output voltage is still available for some time. This prewarning time = t_P is sufficient to save data and start emergency routines.
- The total time, from input voltage failure to output voltage drop, is the buffering time $t_{Buff} = t_B + t_P$, please refer to individual data specifications, buffering time.

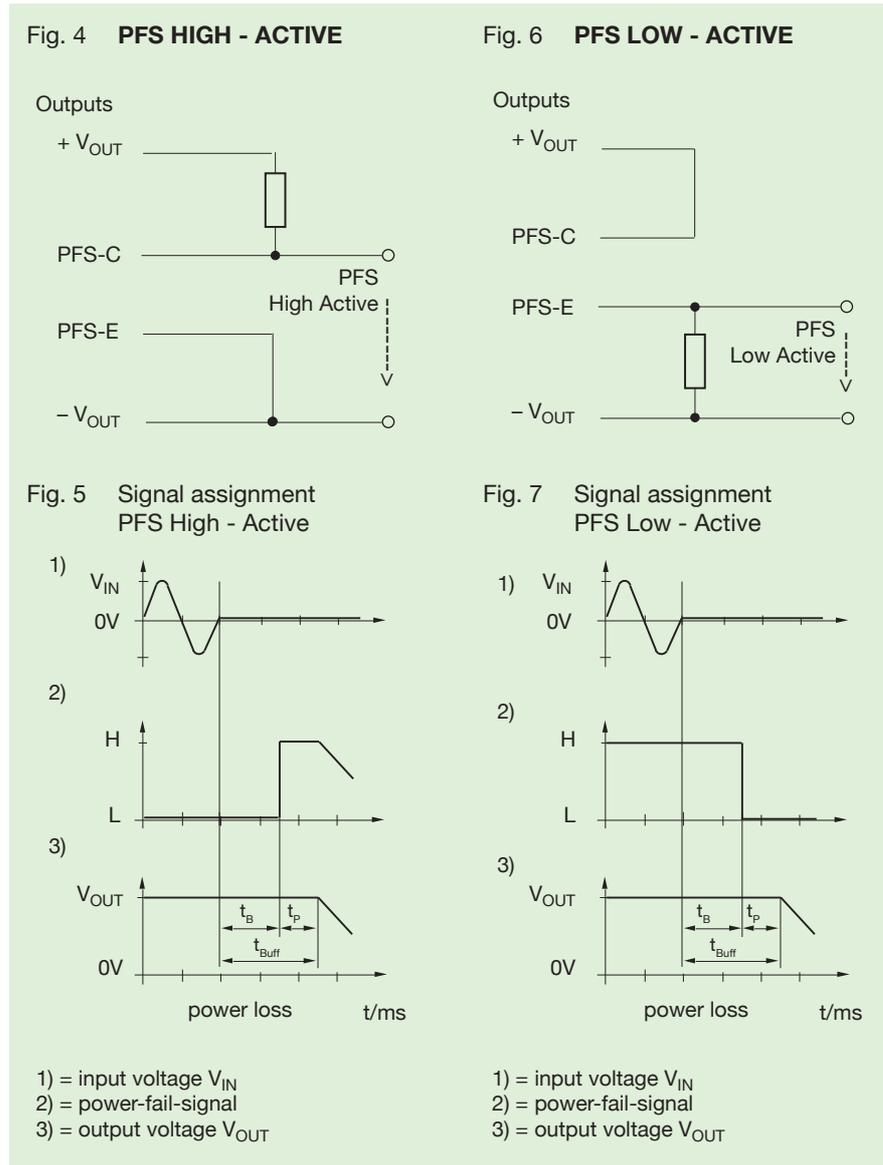
2. $PFS = f(V_{OUT})$

- In the event of unit overload (in case of multiple output only O1), the PFS functions as a warning signal with no prewarning time.

Examples:

Wiring of the floating PFS outputs. See figure 4 and figure 6. In the circuit examples below, a PF signal

is generated, referred to $-V_{OUT}$. The signal voltage is derived from $+V_{OUT}$.



General

The maximum blocking voltage V_{CE} of the output transistor is 30V. A current of 5mA can be switched at a saturation voltage of $\leq 0.8V$.

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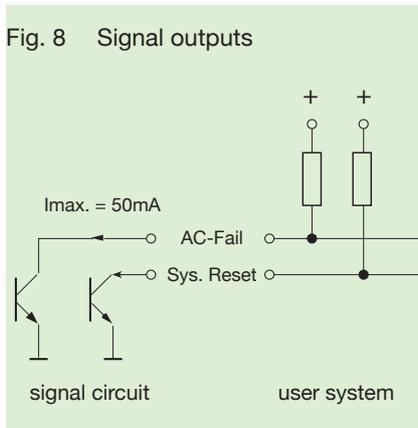


VME Signals

The two VME signals are always referred to the output voltage O1 and have open collector outputs.

In most cases the user circuitry has already got the required pull up resistors. When testing the signals without a connected user system, pull up resistors must be used.

The maximum blocking voltage V_{CE} of the output transistor is 50V. A current of 50mA can be switched at a saturation voltage of $\leq 0.8V$, see figure 8.



Time Specifications According to VME Standards

Fig. 9

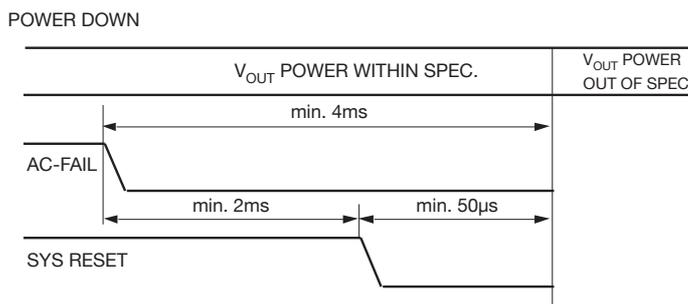
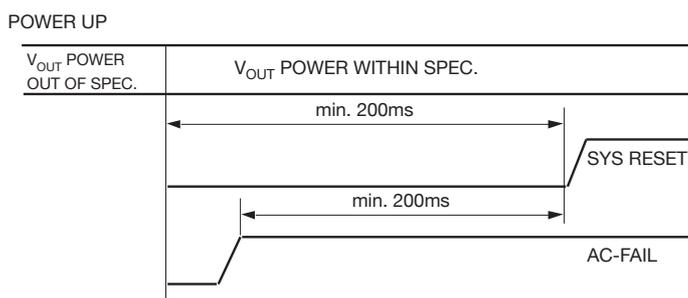


Fig. 10



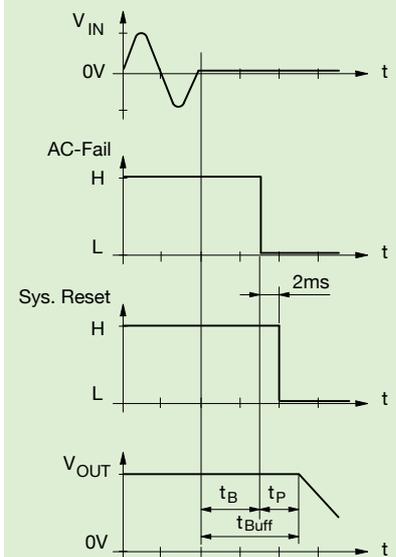
AC-Fail = f (V_{IN}) (see figure 11)

- Brief mains voltage fades are bridged and no fault alarm is generated. Bridging time = t_B .
- If the input voltage remains below the response threshold for a time period longer than the "bridging time", the AC-Fail-signal is activated.
- After the AC-Fail-signal is triggered, the output voltage is still available for some time. This prewarning time = t_P is sufficient to warrant the time specification according to the VME-standard (see figure 9).
- The total time, from input voltage failure to output voltage drop, is the buffering time $t_{Buff} = t_B + t_P$, please refer to individual data specifications, buffering time.

AC-Fail = f (V_{OUT})

- In the event of unit overload (in case of multiple output only O1), the AC-Fail-signal functions as a warning signal with no prewarning time and without time sequence between AC-Fail-signal and Sys-Reset-signal.

Fig. 11



Description Primary Switched Power Supplies

Mechanic, Environmental, Safety

CP, CPD, CPM, CPQ, FP, FPD, FPM, FPQ, CPW, CPWD, CPWM



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.

Safety

CP, CPD, CPM, CPQ, FP, FPD, FPM, FPQ, CPW, CPWD, CPWM



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

CP, CPD, CPM, CPQ, FP, FPD, FPM, FPQ, CPW, CPWD, CPWM

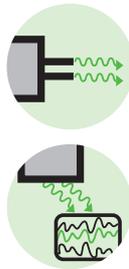


EMC

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. 12 and fig. 13.

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

Fig. 12
Limit value class
150KHz to 30MHz

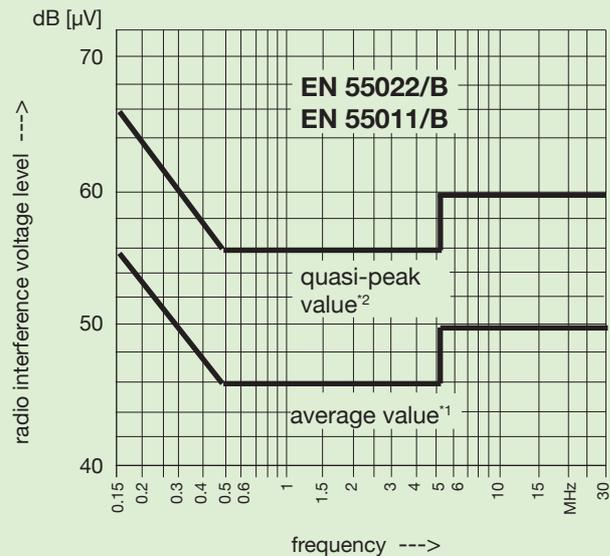
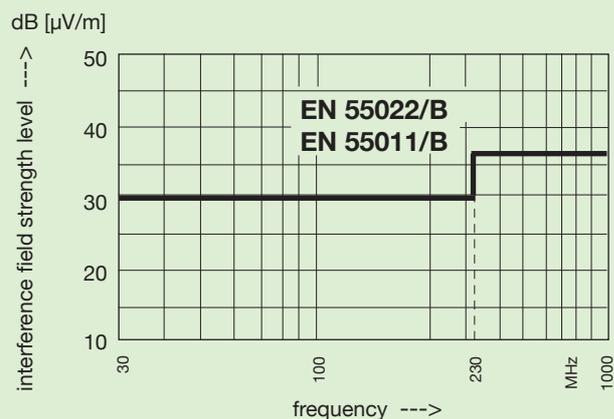


Fig. 13
Limit value class
30MHz to 1 000MHz



*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.

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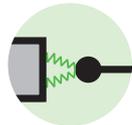


Interference Immunity According to EN/IEC 61000-6-2

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.

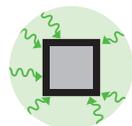
The required test voltage (proof voltage) is:

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

Evaluation criterion B.

Kniel primary switched power supplies meet evaluation criterion A.

Immunity to Electro- magnetic 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.

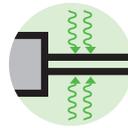
The measurement is carried out in a booth.

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



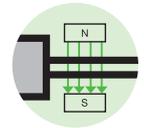
In the frequency band 150kHz to 80MHz, the equipment is subject to modulated fields which induce noise voltages of 10V in the supply lead.

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



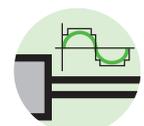
In the frequency range between 50Hz and 60Hz the device is applied with 30A/m. There must be no interference. Kniel primary switched power supplies meet evaluation criterion A.

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.

Limits for Harmonic Current Emissions According to EN/IEC 61000-3-2



Kniel primary switched power supplies of this series fully meet the demands for harmonic current emissions made by EN/IEC 61000-3-2 up to an output power of 150W.

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.