

Description Installation Units

Definition of the Output Data

EXW adjustable V and I



Deviation at Load Variation (static)

On all practical applied regulators there is a small change in the regulating variable (voltage or current) as a reaction to the change in the load, the so called deviation. In the data sheet it is given as a maximum magnitude of change caused by a load variation between 0% and 100% of the regulated variable. Measurement is conducted directly on the female connector with sense leads connected at the measuring point.

Deviation in the Event of a Variation in the Mains (static)

If the mains is varied, the regulating variable will also vary slightly (voltage or current). The data sheets specify the maximum system deviation of the regulating variable caused by a change of 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 current, a 100Hz superimposition on the DC voltage results. This 100Hz ripple is measurable as a residual ripple on the output voltage. Measurement is conducted in voltage regulation mode directly on the female connector with sense leads connected at the measuring point and in current regulation mode directly at the output.

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 fig. 1. This results from charging and discharging of the secondary energy stores at the switching frequency. 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. See fig. 1. 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 fig. 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

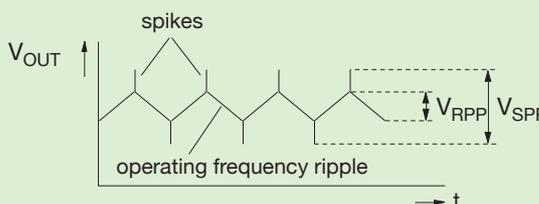
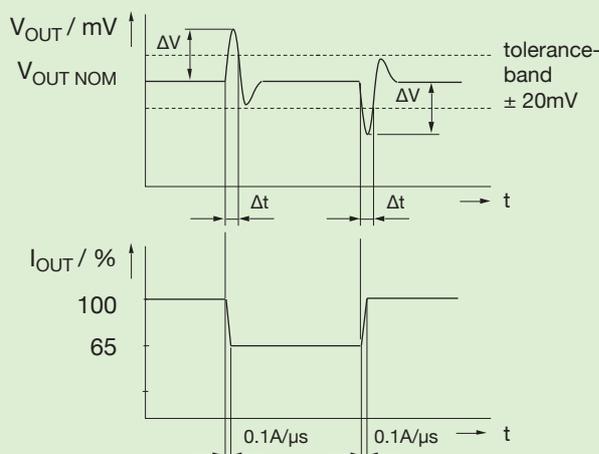


Fig. 2 Voltage variation of the output when subject to a defined sudden load variation



Applications

EXW adjustable V and I



Initial Operation

Preface

In the following sections, the features of the power supplies of the **EXW** series are explained.

The user is provided with the necessary information about how to set up and wire the power supply correctly, as well as about initial operation and operating the power supply.

Before starting up and operating the power supply, please read the section about electrical safety!



The **EXW** family of units provides a voltage at its output terminals which is **electrically isolated** from the mains supply.

In applications above 60Vdc, the user must ensure that the output and load connections as well as the measurement configuration cannot be touched! **The output of appliances without options may be grounded through either the positive or the negative pole.**

The output of power supplies with OP1/OP2 may be earthed only at the negative terminal.



Setting, Display and Operation

The power supply is factory set to the rated values for voltage and current.

The target values can be changed in the indicated range using the potentiometers that are accessible from the outside. The target value increases by turning the target value potentiometer clockwise.

Therefore, at the left stop the target value is at its minimum and at the right stop the target value is at its maximum. If the actual value reaches the target value at the output of the appliance, the controller is activated and keeps the electrical value constant.

The control mode is indicated by LEDs. If the green LED is illuminated (CC), this indicates that the power supply is in current control mode.

The voltage control mode is indicated by the green LED (CV).

In standard mode, one of the two control LEDs is illuminated (CV, CC).

If the operating point shifts as a result of a change of impedance, the control mode may change. In the transition phase, both control indicators may briefly illuminate.

Electrical Safety

The contact safety of the housing in the event of an error is only guaranteed if the protective earth in the **mains input connector X1** is correctly electrically contacted.

(Protection class 1 unit)

This requires for example a sufficient conductor cross section and a professional screwable connection (see layout input/output connector).

When wiring the **output leads** in **connector X 2** a professional contacting of the screw-type terminals and a sufficient cable diameter are required to avoid a risk of overheating and fire (see layout input/output connector).

If the **output is short circuited**, until the current limiter triggers very high currents arise when the output capacitor discharges. The arc formed at the short circuit location can cause hot metal sprays.

Installation and Wiring

When installing the power supply, care must be taken that the air intake is not covered. The same applies to the air outlet of the unit.

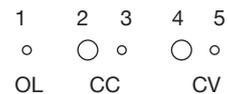
The air flow rate is approx. 0.15 m³/min. at full fan speed.

When wiring the mains connection X1 and DC output connection X2/X3 the information on electrical safety must be observed. Also see chapter "pin configuration".

The power supply does not have a mains switch and is therefore immediately under voltage as soon as the mains input connector is applied with voltage. The unit's connections (mains, output, interface) may only be plugged or unplugged in dead condition. Otherwise the plugs' contacts may be damaged or destroyed.



Control and Display Elements



- 1 - LED red - overload
this lights if the unit is at the power limit
- 2 - potentiometer
for current setting
- 3 - controller LED green (CC)
- 4 - potentiometer
for voltage setting
- 5 - controller LED green (CV)

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Connection of the Load

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

Load Lines (connection X2)

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 (connection X3)

Please note

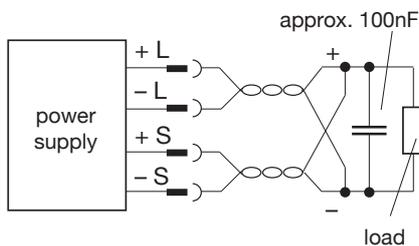
The power supplies are generally ready to operate even if sense leads are not connected.

If the sense terminals are not connected, the device internally adjusts as far as the unit's DC output connector.

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 1V voltage drop 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 (mind polarity).



Input Transient Protection

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

Load-Share

The Load share function provides an active load subdivision, for power supplies in parallel or redundant. The Load share function is active only in voltage regulation mode. The output current of all parallel (or redundant) connected power supplies, becomes balanced in every load point with an exactness of 10% of the maximum output current. Therefore the LS –pin of all in parallel (or redundant) connected power supplies, has to be connected with each other.

Mains Input (wide-range)

The units feature a wide-range input. The permitted input voltage range lies between $V_{IN} = 90$ and $264V_{ac}$ or $V_{IN} = 130...250V_{dc}$.

At an input voltage of $90V_{ac}$ to $150V_{ac}$ ($130...180V_{dc}$), a maximum power drain of 1kW is permitted.

Overvoltage Protection

Thanks to the standard integrated over-voltage protection (OVP) the power supply is being switched off using a second way, independent from the normal control circuit. This state is being stored.

If no energy is being fed from an external source, the output circuit will discharge.

If the overvoltage protection has been triggered by an external overvoltage pulse, normal operation mode of the power supply could be put back into operation by switching the input voltage off ($\geq 1min$ - **mains reset**) or with the standby/on-signal.

Power Factor Correction

The units of the **EXW** series feature active power factor correction. This facility renders the consumed current sinusoidal and reduces the harmonic currents at the device input to a minimum.

See also EMC-limit values for harmonic currents to EN 61000-3-2.

Power Limitation

A series power limitation function protects the device against overload. It is set to the values in the data sheet.

If this value is exceeded, the system limits to maximum value and the output voltage is reduced depending on the magnitude of the overload.

The device reverts automatically to current or voltage-control mode after the fault has been remedied.

Starting Inrush Current

The units of series **EXW** feature an active starting current limitation facility. As soon as the input capacitors have been charged to their nominal voltage, the resistor is bypassed with a relay. After mains failure, the relay is opened again and the starting current limitation facility is reactivated. This facility limits the starting current at every operating point to the value specified in the data sheet.

Temperature Coefficient

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

Description Installation Units

Options

EXW adjustable V and I



Description Option: OP1

Interface connection X4

This version includes the options available with the 15-pin D-Sub interface connector :

- Standby/on
- Parallel-connection contact (PA) for interconnecting several devices
- Load share bus (LS)
In the case of parallel operation and redundant mode, the output currents are balanced to within $\leq 10\%$ accuracy.
- Overtemperature signal (Overtemp)
- Power fail signal (PFS) Optocoupler output
- Auxiliary voltages
12V V_h ($I_{max} = 150mA$)
5V V_h ($I_{max} = 5mA$)

Option: OP2 (decoupling diode)

Interface connection X4

DC output connection X2

In the case of the appliance version OP2 (except EXW 17.70), the output voltage is led to the terminal +R via a decoupling diode. To increase the operating security of the system, these power supplies can be connected redundantly without external components. In this mode, a sensor cable mode is not possible.

An existing PA contact as well as Overtemp may not be connected.

The same options are available with the 15-pin D-SUB interface connection as with OP1.

Description Option OP1 (Interface connection X4)

Signal name	Pin / Symbol	Explanations										
Standby/on GND		<p>The unit can be switched on and off with a control voltage or reset the security cut off. For switch-off, the device auxiliary voltage $V_h = 12V$ (pin 14) on the D-Sub interface connector can be used or any external DC voltage $V_h \leq 20V$, referred to negative-sense.</p> <p>In standby mode, the auxiliary voltages are still available.</p> <p>Voltage levels at the shut down input</p> <table style="margin-left: 20px;"> <tr> <td>unit ON</td> <td>$\leq 0,6V$ or not connected</td> </tr> <tr> <td>unit OFF</td> <td>$\geq 4V$ to max 20V</td> </tr> </table> <table style="margin-left: 20px;"> <tr> <td>$V_{I/O} = 5V$</td> <td>$I_{I/O} \leq 2mA$</td> </tr> <tr> <td>$V_{I/O} = 10V$</td> <td>$I_{I/O} \leq 5mA$</td> </tr> <tr> <td>$V_{I/O} = 20V$</td> <td>$I_{I/O} \leq 10mA$</td> </tr> </table>	unit ON	$\leq 0,6V$ or not connected	unit OFF	$\geq 4V$ to max 20V	$V_{I/O} = 5V$	$I_{I/O} \leq 2mA$	$V_{I/O} = 10V$	$I_{I/O} \leq 5mA$	$V_{I/O} = 20V$	$I_{I/O} \leq 10mA$
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PA GND		<p>In order to boost the power, maximum 3 units may be operated in parallel. For this purpose, the individual PA contacts must be interconnected so that, in the event of a fault (in the case of overvoltage at the output or overheating in a device), the power supplies operated in parallel switch off.</p> <p>In standby mode, all devices are switched off and on via the PA connection. The load leads positive and negative should be interconnected in as balanced a manner as possible.</p> <p>Important: In redundancy operation the PA contacts may not be connected.</p>										
LS (Load share bus) GND		<p>In the case of parallel-connected devices, the LS control unit ensures active load distribution. For this purpose, LS and GND must be connected to the pins of the same name on the parallel unit. The number of parallel units is limited to three. The devices of the same type balance each other to $\leq 10\%$ of the nominal current in voltage-control mode.</p> <p>GND is connected to negative-sense of the DC output.</p> <p>In redundant mode as well, LS may be connected in order to compensate for differing forward voltages of the internal redundant diodes.</p>										

Description Installation Units

Options

EXW adjustable V and I



Description Option OP1 (Interface connection X4)

Signal name	Pin / Symbol	Explanations
Overtemp GND		<p>In the event of overheating, e.g. resulting from inadequate ventilation or excessively high ambient temperature, the unit switches off automatically. This state is signalled at pin 4 (Overtemp) of the D-Sub interface connector. The unit switches back on automatically after it has cooled internally by approx. 30°C.</p> <p>Overtemp signal</p> <p>During overtemperature switch-off, the unit is in standby mode and the auxiliary voltages ($V_h = 12V$, $V_h = 5V$) continue to be available.</p>
PFS (Power Fail Signal) PFS-C PFS-E		<p>The PF signal trips if the input voltage drops below a value at which the nominal output power can no longer be tapped continuously. This signal can be evaluated in order to ensure safe shut-down of installations. When the PF signal trips, the times specified in the data sheet are guaranteed to the user.</p> <p>The terminals are floating. $V_{CEmax} = 30V / I_{Cmax} = 5mA$</p> <p>The transistor is reverse-biased in the event of mains failure (PFS).</p> <p>In power supplies with an output voltage (nominal value) < 90V the transistor will block in the event of secondary undervoltage, eg. in current control mode or in case of an overload. With power supplies with an output voltage (nominal value) > 90V the transistor will block only in the event of undervoltage in the supplying mains network. (t_B, t_P, t_{Buff} see technical data)</p>
12V V_h GND		<p>The 12V auxiliary voltage can supply max. 150mA. GND is connected to negative-sense of the DC output. The 12V auxiliary voltage is also available after overtemperature switch-off or in standby mode. The power supply switch off in case of shorted auxiliary voltage.</p>
5V V_h GND		<p>The 5V auxiliary voltage can supply max. 5mA, has a tolerance of $\pm 1\%$ and temperature coefficient $\alpha \leq 100ppm/K$. GND is connected to negative-sense of the DC output. The 5V auxiliary voltage is also available after overtemperature switch-off or in standby mode. The power supply switch off in case of shorted auxiliary voltage.</p>

Description Installation Units

Options



EXW adjustable V and I

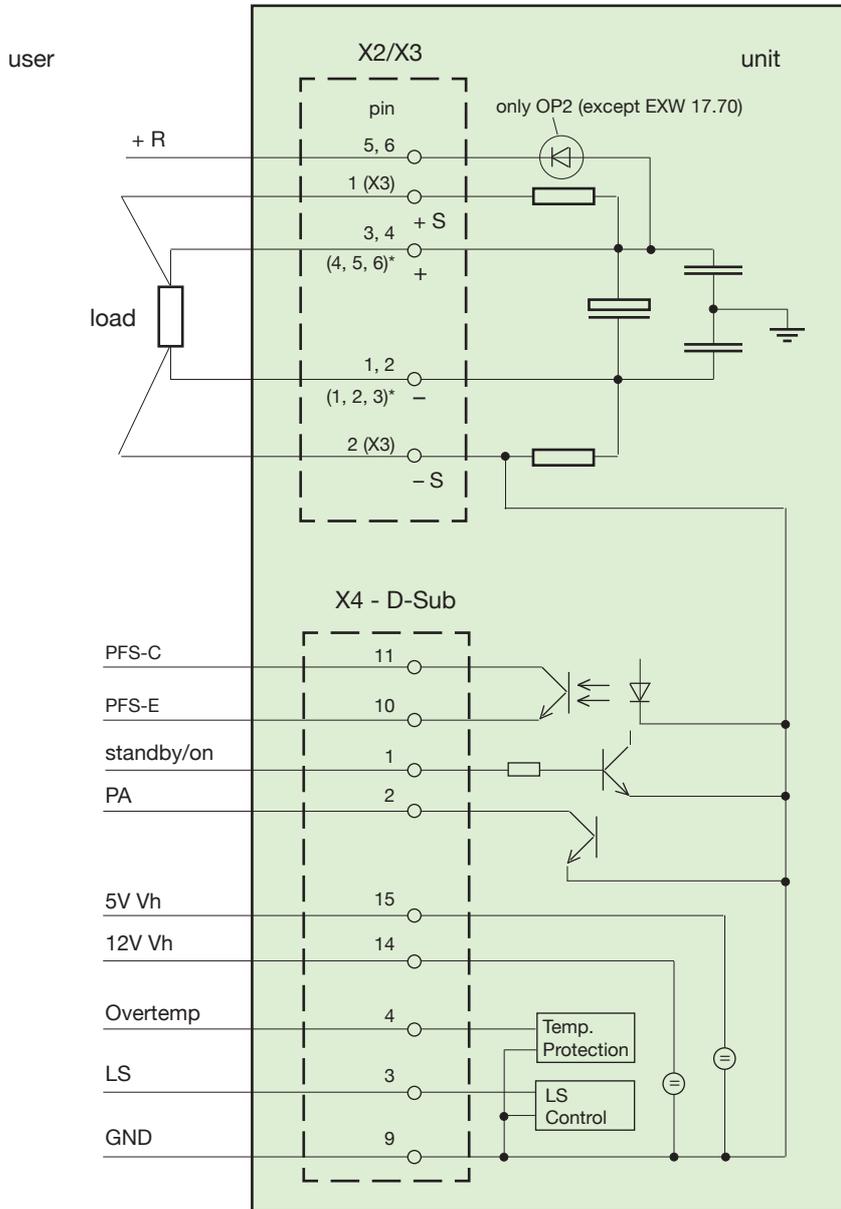
Description Option: OP1 / OP2

As shown in figure 3, all analogue signals, apart from PFS, are referred to negative-sense inside the unit. If the power supply is wired externally, please ensure that no ground loops occur,

that sense resistors are not bypassed and that load currents do not flow to signal GND. Only the opto-coupler terminal (PFS) can be connected voltage-free when

grounding the positive pole, serial circuiting/connecting or positive/negative connecting the power supply.

Fig. 3 Output Circuit EXW



* for EXW 17.70

Description Installation Units

Options

EXW adjustable V and I



Description Option: OP1 / OP2

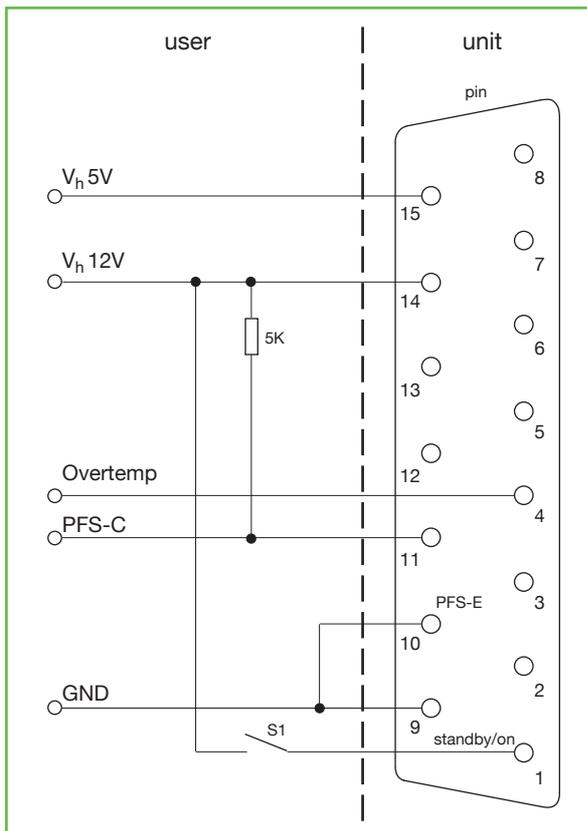
(Interface connection X4)

Application Examples and Wiring

Example 1

Individual Mode

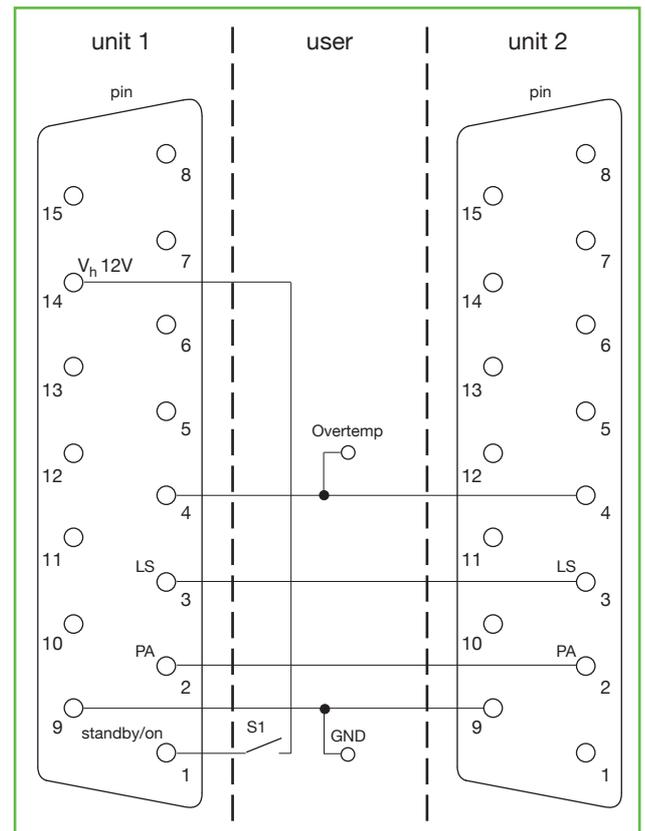
The power supply can be turned on and off using an external switch (S1 closed $\hat{=}$ appliance OFF). The PF-signal is available and is powered by the auxiliary voltage of the power supply. The overtemp indicator and the device-internal auxiliary voltage are also available.



Example 2

Parallel Mode

In case of an error, all power supplies are switched off via the PA connection. In standby/on mode, the second power supply is switched on/off via the PA connection. Current balancing is implemented by the connection of LS. If one power supply overheats, this is indicated at a shared contact.



Description Installation Units

Mechanic, Environmental, Safety

EXW adjustable V and I



Mechanics

The members of the **EXW** family of primary switched power supplies are available either as a built-in version.

The sturdy mechanical structure is of aluminium. All parts of the housing are covered with a conductive chromate finishing.

Extruded profiles developed in-house for cooling brackets and corner profiles form the basis for the finely tuned balance between mechanical sturdiness, protection against electro-magnetic interference and optimal heat dissipation. The cooling is attained through temperature controlled fan operation.

Enclosure rating:
IP 20 according to
EN 60529/IEC 529
when built-in

Mechanical maximum stress:

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

Shock:

10g; duration 11ms
according to DIN 40046
in transport 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

EXW adjustable V and I



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. Signal inputs and outputs (interface connection X4) are to be classified as belonging to the secondary circuit. Every unit is subject to a high-voltage test to ensure that safe electrical isolation is actually provided.

Test voltages (proof voltages)

for units with output voltages

≤ **90V** :

primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	1 200 Vdc

for units with output voltages

> **90V** :

primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	1 610 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.

Power supplies with a guarantee label with a date after February 2008 has an exceeded surge-protection. This protection has to be deactivated before a resit test is possible! Otherwise the resit test will fail.

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 or at DC-input.

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.

EMC

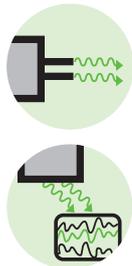
EXW adjustable V and I



EMC

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

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 an average measurement^{*1} or as a quasi-peak measurement^{*2}.

According to fig. 4, the primary switched power supplies meets the limit curve B, according to EN 55022 and EN 55011. 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 for operation in domestic and commercial sectors, are laid down in EN 55022.

Limit values for the industrial sector are defined in EN 55011.

The primary switched power supplies EXW meets the limit curve A, according to fig. 5.

Fig. 4
Limit value class
150kHz to 30MHz

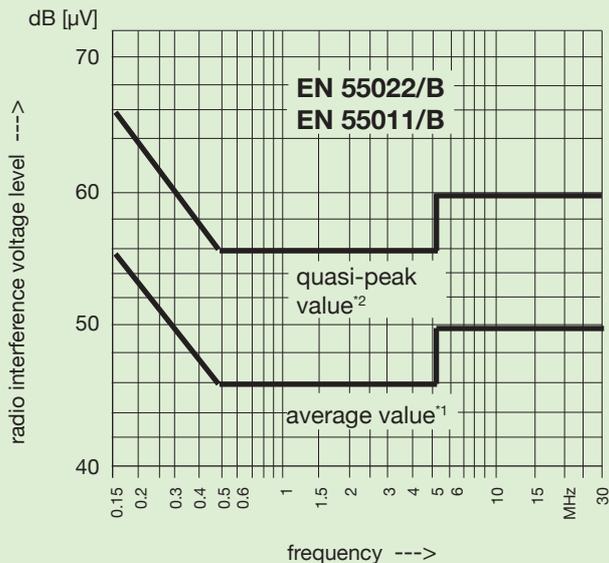
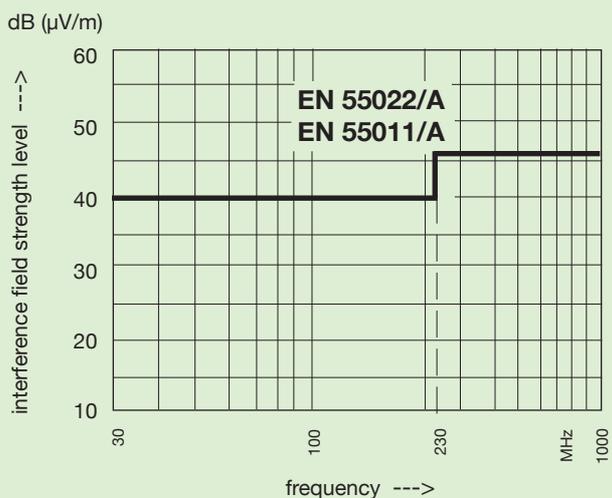


Fig. 5
Limit value class
30MHz to 1 000MHz



*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 Installation Units

EMC

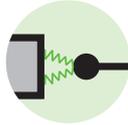
EXW adjustable V and I



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

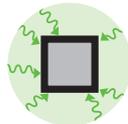


This test verifies the immunity to electrostatic discharge as may occur from the operator's body when touching the equipment. Static discharges as can arise between different objects are also covered with this test. The required test voltage (proof voltage) is:

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

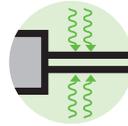
Evaluation criterion B.
Kniel primary switched power supplies meet evaluation criterion A.

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.

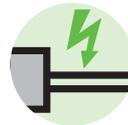
Fast Electrical Transients Burst Test According to EN/IEC 61000-4-4



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 (-).

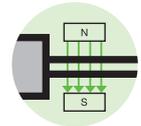
Evaluation criterion B is met.

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



Power supplies of the series EXW are equipped with an active power factor controller. The units achieve $\lambda \geq 0,95$ and meet fully the standards legally required to operate connected with the public power supply system.

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.