

### 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 sheet 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 Input Voltage

If the input voltage is varied, the output voltage will also vary slightly.

The data sheet specifies the maximum control deviation of the output voltage on changing the input voltage between  $V_{INmin}$  and  $V_{INmax}$ .

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

### Residual Ripple (100 Hz)

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

This 100 Hz 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.

### Switching Frequency Ripple

The output DC voltage of the low emission power supply is superimposed by a slight high-frequency AC voltage share, the switching frequency ripple. See figure 1.

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

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

The value specified in the data sheet is the peak-to-peak value  $V_{RPP}$  according to figure 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 20 MHz.

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 the case of abrupt load changes at the output of the module. See figure 2.

The causes of the control deviation ( $\Delta V$ ) is the energy stored in the output circuit and the limited speed of the controller. The recovery time ( $\Delta t$ ) is defined as the time until the output voltage is once again within a tolerance band after a load change. The tolerance band is defined as  $\pm 20$  mV. The voltage and current characteristics dependent on time are shown in figure 2. Measurement is conducted directly on the female connector with sense leads connected at the measuring point.

Fig. 1  
Output voltage

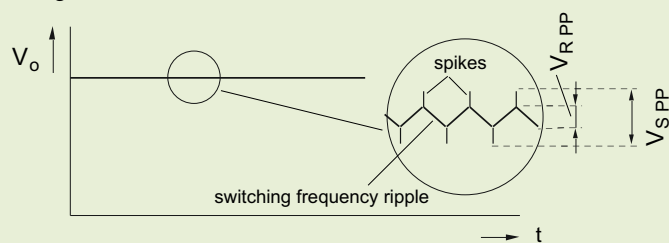
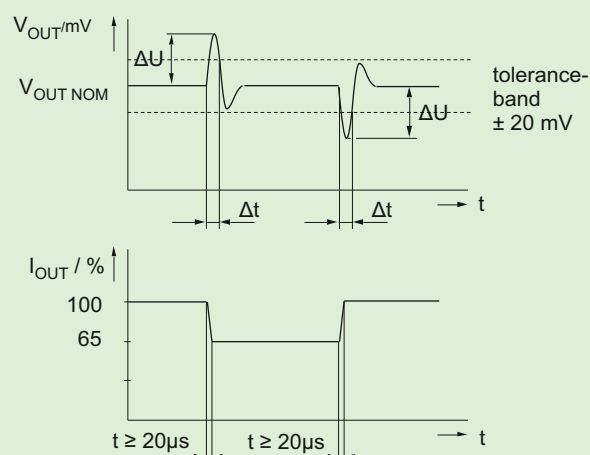


Fig. 2  
Voltage variation of the output when subject to a defined sudden load variation



### 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

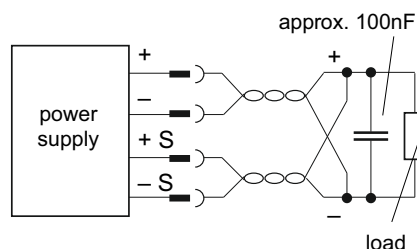
The power supplies are generally ready to operate even if sense leads are not connected.

#### 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 to the values specified in the technical data 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 Conversion for AC/DC Converters 3 U and 6 U and Single Output Modules MAA...

Low emission units automatically switch to 115 Vac or 230 Vac input voltage.

#### Note

If the mains voltage is altered from 115 Vac to 230 Vac a change-over occurs automatically. If the mains voltage drops from 230 Vac to 115 Vac, the unit remains in the 230 Vac range due to safety reasons. In order to reactivate the 115 Vac range the unit first has to be switched off.

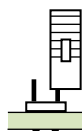
The power supply may not be operated outside the defined mains input voltage range.

### Changing the Mains Input Voltage for AC/DC Converter Modules MA... and MAD...

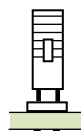
If necessary, for Low emission AC/DC-converter modules the factory setting can be changed from 230 Vac to 115 Vac (or reverse) by changing a jumper on the board. The unit must be opened to do this.

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

230 Vac  
bridge open



115 Vac  
bridge closed



#### Note

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

The desired input voltage selection can be ordered ex works.

### 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 resistor of the equipment, the lead resistor and the impedance of the main.

#### Definition

To measure the inrush current, a network simulation is used with  $0.5 \Omega$  ( $0.4 \Omega + j 0.25 \Omega$ ). The lead-in has a length of 1 m and a line diameter of  $2.5 \text{ mm}^2$ .

#### 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.

### Input Transient Protection

For the low emission units, a varistor or a suppressor diode is used for transient protection. This limits overvoltages at the input of the appliance, e.g. when switching off inductances.

### 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. 4 V, 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. 20 V

$V_{IO} = 5 \text{ V}$   $I_{IO} \leq 2 \text{ mA}$

$V_{IO} = 5 \text{ V}$   $I_{IO} \leq 10 \text{ mA}$

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

## Description Low Emission

## Applications

CA, CAA, CAD, CAAD, CAAM, MA..., MAD..., FA, FAD, FAM, FAQ



### Load-Share (Series CAA 12 HP)

The Load share function provides an active load subdivision, for power supplies in parallel or redundant. The Loadshare 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.

### Parallel Connection (single output)

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 leads + and - should be interconnected in as balanced a manner as possible.

### Parallel Connection (multiple output)

In power supplies with two or more outputs no parallel connection is possible.

### Electrical Isolation

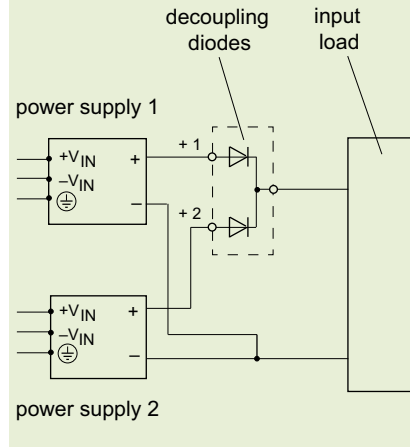
On Kniel low emission power supplies, all inputs and outputs are electrically isolated. This means that the outputs can be freely interconnected. (Pay attention to the breach of security!)

### Redundancy Operation

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

Fig. 3



### Current Limitation

Kniel low emission units 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.

### Temperature Coefficient

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

### Test Sockets

The test sockets are exclusively designed for loadless measuring the actual value of the output voltage of the power supply.

Without connected sense leads the measured voltage is equivalent to the voltage at the output of the power supply.

With connected sense leads the measured voltage is equivalent to the voltage at the input of the load.

The terminals of the test sockets are connected to the appropriate sense leads and not suitable for checking current values.

Matching test probes are available at Schurter Electronic Components (<http://www.schurter.ch>).

Order number      colour

0040.1161          black

0040.1162          red

### Overvoltage Protection Output (without CAD, MA..., MAA..., MAD...)

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.

### Overvoltage Protection Output (CAD, MA..., MAA..., MAD...)

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, the overvoltage will be limited by a TVS diode. The power supply will go to normal operation, after the external fault has been remedied.

## Description Low Emission

## Mechanic, Environmental, Safety

CA, CAA, CAD, CAAD, CAAM, MA..., MAD..., FA, FAD, FAM, FAQ



### Mechanical 19"-System

Kniel low emission units 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 +50° 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:

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

Shock:

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

### Mechanical - Modules

Kniel low emission modules are compact, flexible power supplies. They can be attached longitudinally and at the end face on DIN rail mounts, screwed laterally on 6 U card magazines, on the back of assembly racks and even lying in 1 U card modules. Specifically developed press-drawn sections for the complete mechanic system form the basis for the finely tuned system between mechanical strength, protection against electromagnetic interference, and optimum heat dissipation. All parts of the housing are covered with the protective green special lacquer with a conductive chromate layer.

Degree of protection:

IP 20 according to  
EN 60529/IEC 529

Mechanical load rating:

Vibration:

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

Shock:

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

### Environmental

Operating temperature range:

see data sheet,

Storage temperature:

see data sheet.

Humidity: 95 %,

without condensation.

### RoHS

Information on the conformity of the power supplies with the different versions of the RoHS Directive can be found on our website, see <https://kniel.de/rohs-declaration>

### WEEE

Information on the conformity of the power supplies with the different versions of the WEEE Directive can be found on our website, see <https://kniel.de/weee-declaration>

### Electrical Safety



Power supplies from Kniel System-Electronic GmbH are designed to cover a broad range of applications. To ensure that common regulations applicable to different fields of application are observed, the primary switched-mode power supplies are built in accordance with EN 60950/IEC 950 for safety of data processing equipment, including electrical office machines.

### Important Electrical Safety Features

The output circuit is electrically isolated from the input circuit. Electrical isolation between the primary circuit and secondary circuit is achieved by adequate air gaps and creepage distances.

### Safety

NRTL / QPS Evaluation Series Inc.



Power supplies with the QPS mark of conformity on the nameplate are certified according to the standards listed below.

This accredited test laboratory fulfils the conditions as NRTL (Nationally Recognized Testing Laboratory) in the USA.

The datasheets of those devices that are certified according to the following standards and whose production is monitored list the standards on the title page of the datasheet.



UL 60950-1  
CSA C22.2 No. 60950-1  
IEC 60950-1

Typographical or other errors and technical changes reserved.

**Safety**

CA, CAA, CAD, CAAD, CAAM, MA..., MAD..., FA, FAD, FAM, FAQ

**Test Voltages**

Every power supply is subjected to a high-voltage test to ensure that safe electrical isolation is actually provided. The test voltage for secondary ↔ protective earth (PE) is dependant on the nominal output voltage of the power supply, see table below.

**SELV**

Power supplies from Kniel System-Electronic GmbH with an output voltage of up to 54 Vdc comply with the requirements of SELV circuits. SELV circuits must feature safe electrical isolation from the mains.

**Networks**

Tested for IT networks.

Nominal output voltage ( $V_{OUT}$ )	primary ↔ secondary ( $V_{OUT}$ )	primary ↔ protective earth (PE)	secondary ( $V_{OUT}$ ) protective earth (PE)	secondary ↔ secondary
$V_{OUT} < 60 \text{ V}$	4250 Vdc	2150 Vdc	700 Vdc	700 Vdc
$60 \text{ V} < V_{OUT} < 75 \text{ V}$			1020 Vdc	1020 Vdc

**CAUTION:**

Repeat testing by the customer is not recommended, damage to semiconductors and insulation cannot be ruled out. If another high-voltage test is mandatory, the test conditions must be coordinated with Kniel System-Electronic GmbH beforehand. Otherwise the warranty is void.

**Definition of the Ambient Conditions according to the standards set in chapter "Safety"****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. Over-voltages resulting from switching operations must be taken into consideration.

**Definition of the Safety Class**

The 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 3.5 mA. Power supplies of this series are compliant to this value between 45 and 440 Hz frequency of the mains. The actual leakage current of the low emission units is typical 0.1 mA between 45 and 66 Hz frequency of the mains.

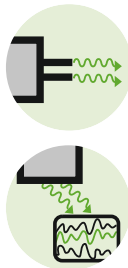


## EMC

The low emission units 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 low emission units 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 150 kHz to 1 000 MHz.

Up to 30 MHz the interference voltage is measured and evaluated on lines. Either as a average measurement<sup>\*1</sup> or as a quasi-peak measurement<sup>\*2</sup>.

In the higher frequency range of 30 MHz to 1000 MHz the interference fields emitted in 10 m 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 low emission units are used in residential and commercial buildings the limit curve **B** must be upheld.

See figure 4 and figure 5.

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

Fig. 4

Limit value class  
150 kHz to 30 MHz

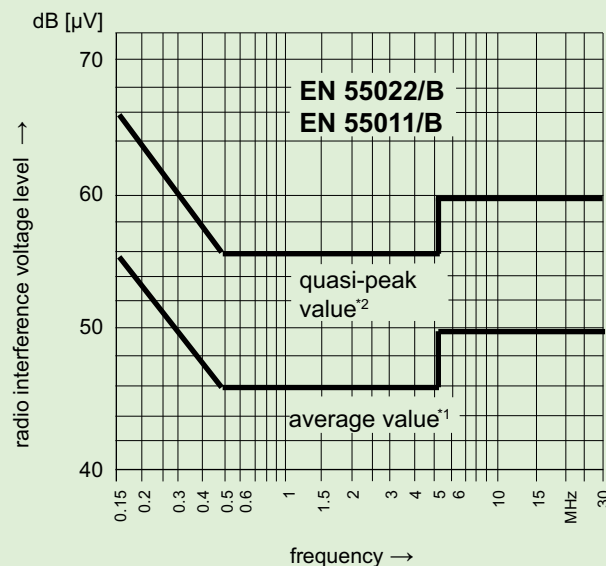
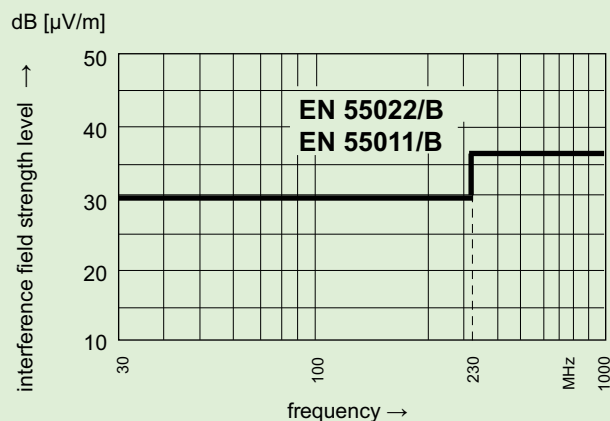


Fig. 5

Limit value class  
30 MHz to 1000 MHz



\*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.

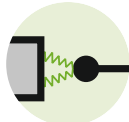


#### Interference Immunity According to EN/IEC 61000-6-2

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 low emission units.

#### ESD - Immunity to Electrostatic Discharge According to EN/IEC 21000-4-2



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:

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

Evaluation criterion B.

Kniel low emission units 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 80 MHz to 1000 MHz with a field strength of 10 V/m.

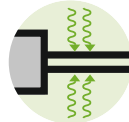
The measurement is carried out in a booth.

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



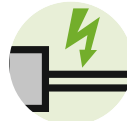
Fast transient bursts occur during switching operations, e.g. disconnecting inductive loads and bounce of relay contacts, in all electrical power supply systems.

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 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:

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

Evaluation criterion B is met.

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

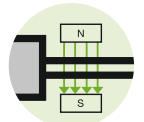


In the frequency band 150 kHz to 80 MHz, the equipment is subject to modulated fields which induce noise voltages of 10 V in the supply lead. No limit values or maximum permissible deviations are stipulated in the standard.

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



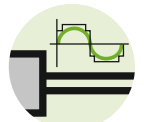
In the frequency range between 50 Hz and 60 Hz the device is applied with 30 A/m. There must be no interference. Kniel low emission units meet evaluation criterion A.

#### Voltage dips or interruptions according to EN/IEC 61000-4-11



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

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



The requirements demanded by EN/IEC 61000-3-2 for harmonic current emissions 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.