Description Modules

Definition of the Output Data

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

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 Input Voltage

If the input voltage is varied, the output voltage will also vary slightly.
The data sheets specify the maximum system deviation of the output voltage when subject to a change in 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 (100Hz) (Primary Switched Power Supplies)

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 the modules is characterized by a slight superimposed AC voltage component, the operating frequency ripple. See fig. 1.
This results from charging and discharging of the secondary energy story mechanisms with the switching frequency of the module.
Measurement is conducted directly on the female connector with sense leads connected at the measuring point.
The value in the data sheet is the peak to peak value $V_{S\ PP}$ 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 $V_{S\ PP}$ as shown in figure 1.

Dynamic Voltage Deviation and Regulation Time

Voltage overshoot and undershoot occur in the case of abrupt load variations of the output of the module. See figure 2.
Causes of the voltage deviation (ΔV) is 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 ± 20mV. The voltage and current characteristics as a function of 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

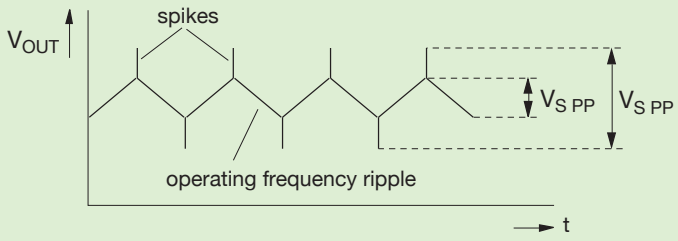
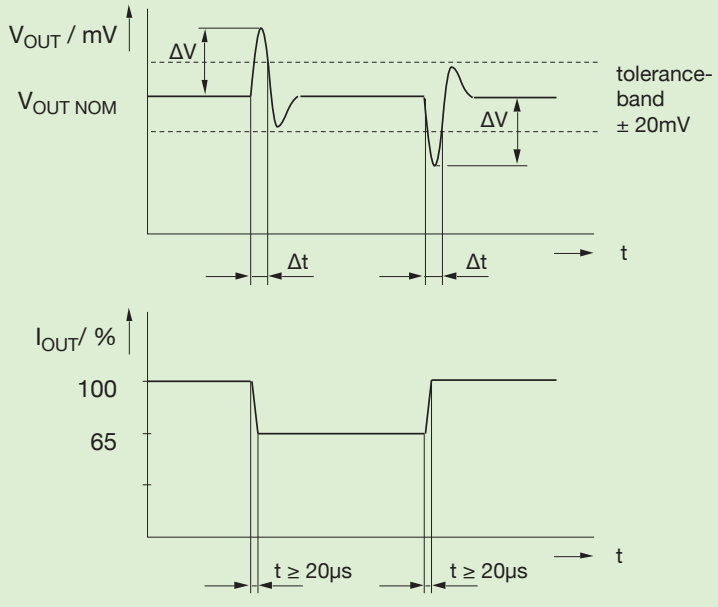


Fig. 2
Voltage variation of the output when subject to a defined sudden load variation



Applications

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

EMC + Safety tested

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 of approx. 100nF even if no sense leads are connected.

Sense leads

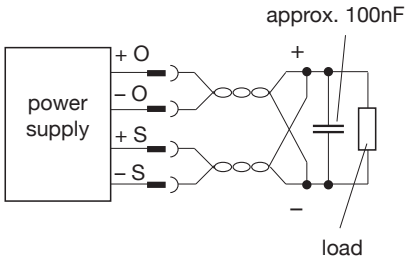
The power supplies are generally ready to operate even if sense leads are not connected.

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.

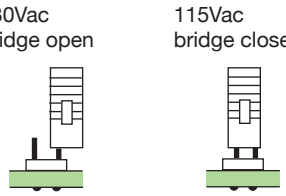


Changing the Mains Input Voltage

(Primary Switched Power Supply Modules Series 140/160)

If necessary, for primary switched power supply modules the factory setting can be changed from 230Vac to 115Vac (or reverse) by changing over a jumper on the pc-board. The unit must be opened to do this.

Before changing the input voltage, the power supply has to be disconnected from the mains.



Input Voltage

(Modules with DC-input)

The modules are equipped with powerful smoothing capacitors at the input. Therefore the external filtering of a rectified AC voltage is not entirely necessary. The permitted super-imposed AC voltage is 10% of the supply voltage. If there is a higher super-imposed AC voltage, we recommend additional smoothing capacitors. The output voltage is not influenced by the superimposed AC voltage. (Also see decoupling diode option page 5.)

Input Transient Protection

A suppressor diode is used as transient protection for DC/DC-modules. For modules with a mains input a varistor between L1 and N takes over this function. As a result overvoltages such as those which occur when switching off inductive circuits can be limited at the unit input.

Starting Inrush Current

The power drain of modules at the switch-on time is determined by the input capacitors of the unit.

In order to selectively protect the modules, the user requires the specification of the starting inrush current which is characterised by the current integral and the maximum current surge.

Depending on the input voltage and performance class, some of our modules have built-in NTC resistors to limit the starting inrush current. These NTC resistors are high ohmic in a cold state and thus limit the starting inrush current.

On reaching their operating temperature they become low ohmic and only become effective again after they have cooled down. This is why two values are specified in the data sheets for our units (see technical data: "unit cold" and "worst case").

For unit types without NTC resistors only the "worst case" specification is listed.

Definition

To measure the starting inrush current for input voltages larger than 75V a network simulation with 0.5Ω (0.4Ω + j0.25Ω) and for input voltages lower than 75V a network simulation with 100mΩ/150µH is used. The power line is 1m long in both cases and has a line cross section of 2.5mm^2.

Note

In order that the starting inrush current stated in the data sheet for "Unit cold" is not exceeded, the power supply must remain switched off for about 5 minutes at an ambient temperature of ≤ 25°C.

Extern ON/OFF

(Modules with AC-input)

The modules may be switched on and off by an external control voltage. The control voltage referred to the output ground (– O1).

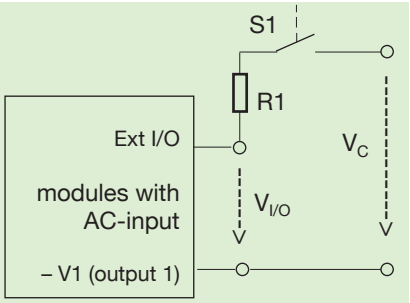
It is not possible to use the output voltage of the power supply to switch itsself off. The power supply can not deliver an output voltage of min. 4V, while it is switched off.

Voltage Levels at the Extern ON/OFF-Input
Unit ON ≤ 0.6V or not connected
Unit OFF ≥ 4V to max. 30V
$V_{I/O}$ = 5V $I_{I/O}$ ≤ 2mA
$V_{I/O}$ = 30V $I_{I/O}$ ≤ 15mA

Applications

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

Example of a circuit for voltage level >30V at modules with AC-input:



S1 closed ≙ unit off
$(4V \le V_{I/O} \le 30V)$

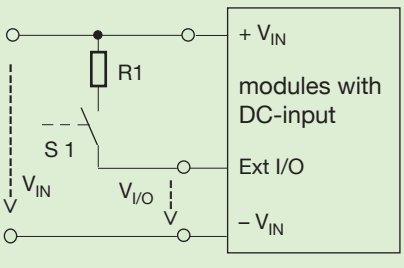
$$R1_{max} = \frac{V_C - 4V}{2mA}$$

(Modules with DC-input)

The modules may be switched on and off by an external control voltage. The control voltage referred to the input ground ($-V_{IN}$) and can be derived from a separate voltage or from a dropping resistance of $+V_{IN}$.

Voltage Levels at the Extern ON/OFF-Input	
Unit ON	≤ 0.6V or not connected
Unit OFF	≥ 4V to max. 36V
$V_{I/O}$ = 5V	$I_{I/O} \le$ 2mA
$V_{I/O}$ = 36V	$I_{I/O} \le$ 20mA

Example of a circuit for voltage level >36V at modules with DC-input:



$$R1_{max} = \frac{V_{INmin} - 4V}{2mA}$$

S1 closed ≙ unit off
$(4V \le V_{I/O} \le 36V)$

$V_{I/O}$ = voltage at Extern ON/OFF
V_C = external control voltage
V_{IN} = input voltage

Base Load

The multiple voltage units are equipped with a base load as standard. This ensures that even when the primary circuit is unloaded, the secondary circuits can still be loaded according to the specifications in the data sheets (please refer to data sheet).

Multiple Voltage Units

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

Parallel Connection

No parallel connection is available.

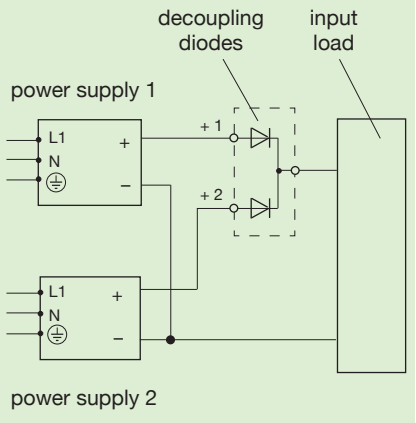
Electrical Isolation

On Kniel modules 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.
In the case of redundancy operation, the unit outputs must be decoupled by diodes. In this operating mode, sense lead operation is impossible.
See figure 3.

Fig. 3



Current Limitation

Kniel modules are protected against overload by a built-in current limitation and are continuously short circuit proof.
The current limitation is factory set to the value specified in the technical data. If this nominal value specified is exceeded, the output current is limited to the maximal value and the voltage is reduced in accordance with the dimension of the overload.
Circuit V1 has a V/I characteristic curve.
Circuits V2/V3 have a foldback current limitation characteristic curve.
The unit automatically returns to voltage control after the fault has been remedied.

Temperature Coefficient

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

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 module is switched off. The residual voltage of the output is zero after switch-off of the module. 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.

EMC + Safety tested

PFS - Power-Fail Signal

The power-fail signal should always be activated if the power supply at the input of the load is at risk.
It is advisable to activate the power-fail signal before the output voltage drops since this is the only way of storing important data or starting emergency routines. See figures 5 and 7.
The standard Power-Fail Signal response threshold is set to V_{INNOM} –20% (other settings available on request).
On units with V_{INDC} = 36... 75V, the nominal operating voltage for setting the response threshold 48V or 60V must be specified by the customer.
The power-fail signal is available separately and electrically isolated via optocouplers 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, the PFS functions as a warning signal with no prewarning time.

Examples:

Wiring of the floating PFS outputs.
See figures 4 and 6.
In the circuit examples below, a PF signal is generated, referred to – V_{OUT}. The signal voltage is derived from +V_{OUT}.

Fig. 4 **PFS HIGH - ACTIVE**

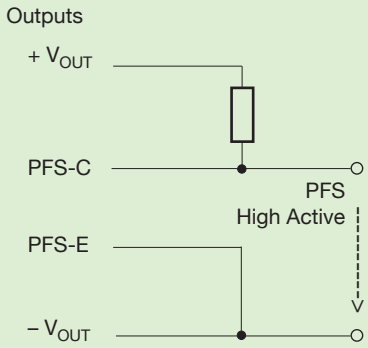
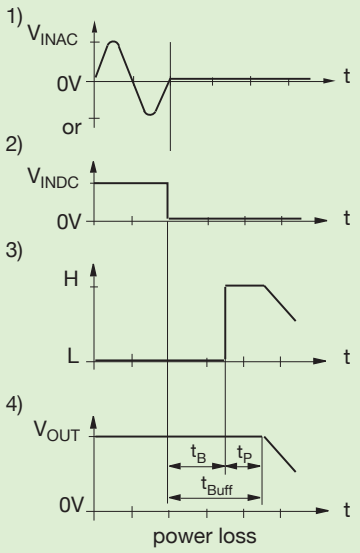


Fig. 5 Signal assignment
PFS High - Active



1) = input voltage V_{INAC}
2) = input voltage V_{INDC}
3) = power-fail signal
4) = output voltage V_{OUT}

Fig. 6 **PFS LOW - ACTIVE**

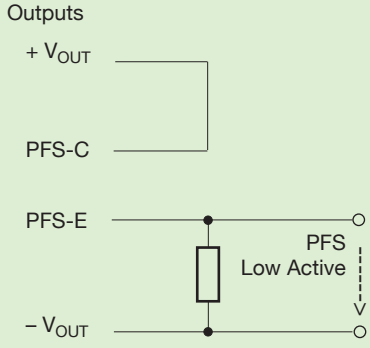
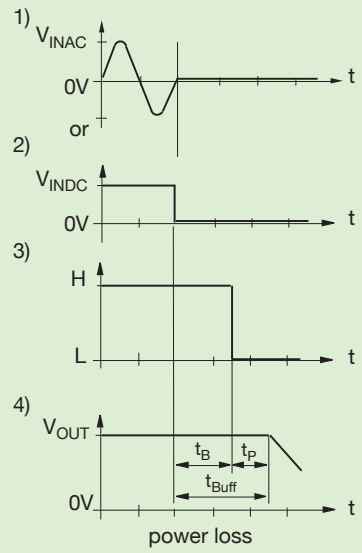


Fig. 7 Signal assignment
PFS Low - Active



1) = input voltage V_{INAC}
2) = input voltage V_{INDC}
3) = power-fail signal
4) = output voltage 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 ≤ 0.8V.

Options (for units with DC-voltage input)

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

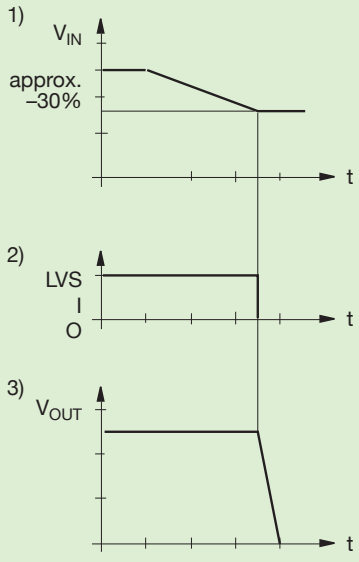
LVS - Low-Voltage Shut-Down

DC/DC-converter-modules are frequently powered by accumulators. The DC/DC-converter module is switched off at an adjustable threshold in order to protect the accumulator against exhaustive discharge. If the input voltage is increased by approx. 10%, the unit switches back on. The switching threshold is set as standard to approx. V_{INNOM} – 30%, see figure 8 (other threshold settings are available on request).

On units with V_{INDC} = 36... 75V, the nominal operating voltage for setting the response threshold 48V or 60V must be specified by the customer.

If the LVS signal is used in conjunction with the PFS (VME) signal, the time from activation of the power-fail signal through to switch-off of the DC/DC-converter module (prewarning time) will depend on the capacity of the accumulator.

Fig. 8



1) = input voltage V_{IN}
2) = low-voltage shut-down (internal shutdown)
3) = output voltage V_{OUT}

Decoupling Diode

DC/DC-converter-modules with the "Decoupling Diode" option have a forward-biased diode built into the input circuit. This means that, should a fault occur in the feeding system, e.g. in the event of short circuit, the energy of the input electrolytic capacitors is made available to the modules output and does not drain into the power system. This means that short voltage fades do not influence the output voltage. We are thus able to guarantee buffer times only with decoupling diode fitted.

The input fuse does not blow if the polarity of the fitted decoupling diode is reversed. The efficiency reduces between 1 and 5% owing to losses in the decoupling diode. Use of the decoupling diode is recommended in the case of a supply voltage with high superimposed AC voltage.

Description Modules

Mechanic, Environmental, Safety

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

CE
EMC + Safety tested

Mechanical System

Kniel 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 30 according to
EN 60529/IEC 529

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

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

Electrical Safety

The units are designed to cover a broad range of applications. The modules 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) for DC/DC-Converters:

V_{IN} = 18 V ... 36 V:

primary	- secondary	1 500 Vdc
primary	- PE	1 000 Vdc
secondary	- PE	700 Vdc

V_{IN} = 36 V ...75 V:

primary	- secondary	2 500 Vdc
primary	- PE	1 500 Vdc
secondary	- PE	700 Vdc

V_{IN} = 75 V ... 300 V:

primary	- secondary	3 800 Vdc
primary	- PE	2 400 Vdc
secondary	- PE	700 Vdc

Test Voltages (proof voltages) for Primary Switched Power Supplies:

V_{IN} = 115 V / 230 V:

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 Messrs. 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

The modules 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. Kniel power supplies of this series do not exceed this value between 45 and 66Hz frequency of the mains or of 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

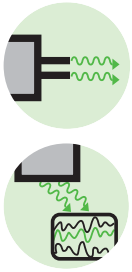
MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

EMC + Safety tested

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.
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 the modules radiated noise is generated by high-frequency, periodic switching operations.
The higher the switching frequencies and the steeper the rising or trailing edges of current and voltage are, the higher will be the high-frequency share of the noise spectrum.
The noise spectrum is considered over a bandwidth of 150KHz to 1 000MHz.
Up to 30MHz the interference voltage is measured and evaluated on lines. Either an average measurement*1 or as a quasi-peak measurement*2.
In the higher frequency band between 30MHz and 1 000MHz, the radiated interference fields are recorded at 10m distance.
The permitted limit values are intended to prevent neighboring electronic equipment being affected by interference. Corresponding limit values are stipulated in EN 55022.
Limit curve B must be observed if the modules are used on residential or commercial premises or in public facilities. See figure 9 and figure 10.
The limiting values for industrial applications are defined in EN 55011.

Fig. 9
Limit value class
150KHz to 30MHz

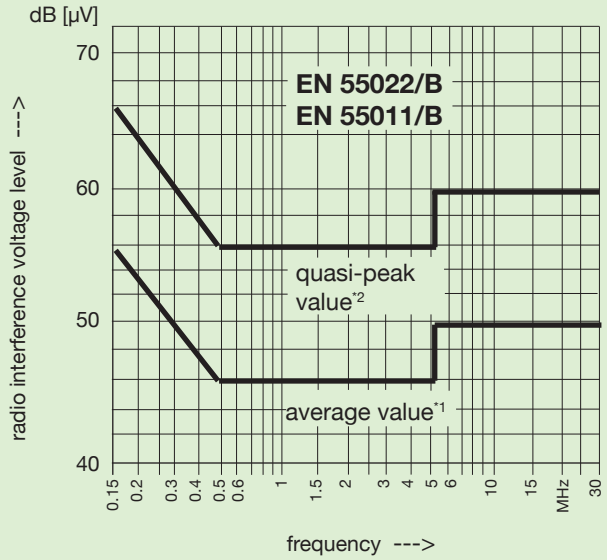
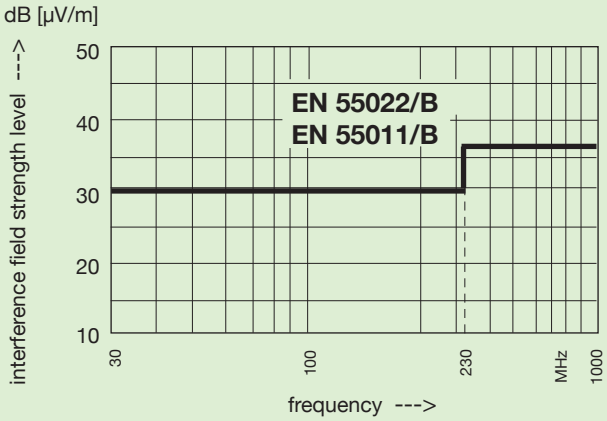


Fig. 10
Limit value class
30MHz to 1 000MHz



*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 Modules

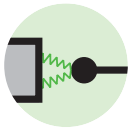
EMC

MP…, MPD…, MPM…, MDC…, MDCD…, MDCM…

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

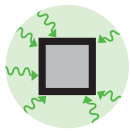
The immunity to electromagnetic interference, as occurs in practice as the result of static discharges, switching operations on inductive circuits and capacitors, as the result of lightning strike and as the result of high-frequency pick-up, is verified by a series of tests.
Limit values according to EN/IEC 61000-6-2 (Industrial application) apply for Kniel modules.

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



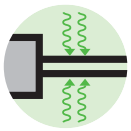
This test verifies the immunity to electrostatic discharge as may occur from the operator's body when touching the equipment. Static discharges as can arise between different objects are also covered with this test.
The required test voltage (proof voltage) is:
8kV - discharge in air
4kV - contact discharge.
Evaluation criterion B.
Kniel modules meet evaluation criterion A.

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



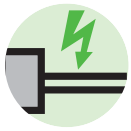
Electromagnetic fields are generated by radio-telephony equipment, radio broadcasting stations, TV stations and other industrial electromagnetic interference sources. The aim of this standard is to increase immunity of equipment. The test covers the frequency band from 80MHz to 1 000MHz with a field 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:
The starting voltage may not deviate more than 2% from the value set.

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 loads is not impaired on a sustained basis as the result of these extremely brief voltage peaks.
The standard requires evaluation criterion B.
Kniel modules 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 a lightning strike.
DC/DC-Converters:
A possible voltage amplitude of 500V is assumed for DC power systems.
The standard requires evaluation criterion B.
Kniel modules meet evaluation criterion A.

Primary Switched Power Supplies:
For AC/DC-Converters the standard requires:

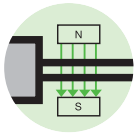
2kV	L1 / N	-->	SL
1kV	L1	-->	N.

The 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:
The output voltage may not deviate by more than 2% during this test.

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

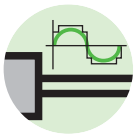


In the frequency range between 50Hz and 60Hz the device is applied with 30A/m. There must be no interference.
Kniel modules comply with assessment criterion A.

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



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.