Description Linearly Regulated Power Supplies

Definition of the Output Data

BUI / CUI V_{out} and I_{out} programmable

Output Voltage Rise/Fall at Programming

If the programming is varied jumpy, the output voltage cannot follow immediatly. The vary of the output voltage has a limited speed. This speed is defined in the data sheet.
Values are measured directly on the female connector with sense leads connected at the measuring point.

Output Current Rise/Fall at Programming

If the programming is varied jumpy, the output current cannot follow immediatly. The vary of the output current has a limited speed. This speed is defined in the data sheet.
Values are measured directly at the output of the power supply.

Voltage Deviation at Load Variation (static)

On all practically applied voltage regulators there is a small change in the output voltage as a reaction to a change in the load, the so-called deviation. In the data sheets it is given as the maximum magnitude of change caused by a load variation between 0% and 100% of the nominal current.
Values are measured 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 system deviation of the output voltage caused by a change of the mains between V_{INmin} and V_{INmax}.
Values are measured directly on the female connector with sense leads connected at the measuring point.

Current Deviation at Load Variation (static)

On all practically applied current regulators there is a small change in the output current as a reaction to a change in the load-resistance, the so-called deviation.
In the data sheets it is given as the maximum magnitude of change caused by a load variation between 0% and 100% of the nominal voltage.
Values are measured directly at the output of the power supply.

Current Deviation in the Event of a Variation in the Mains

If the mains is varied, the output current will also vary slightly.
The data sheets specify the maximum system deviation of the output current caused by a change of the mains between V_{INmin} and V_{INmax}.
Values are measured directly at the output of the power supply.

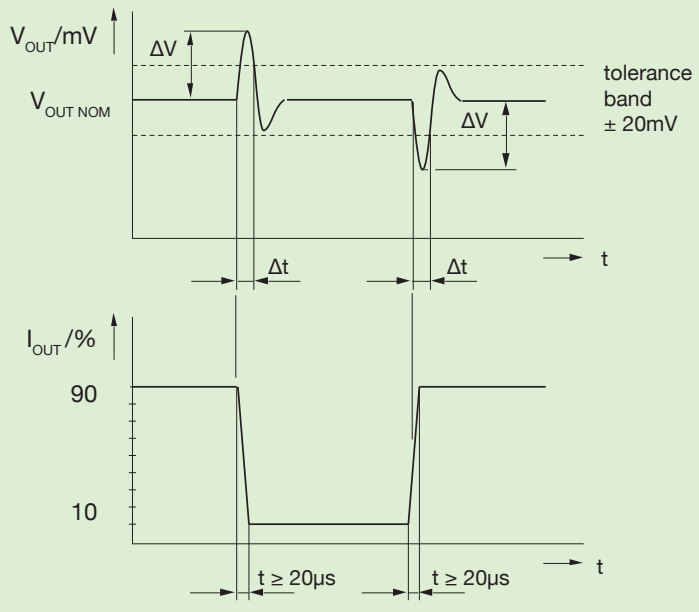
Residual Ripple (100Hz)

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.
In voltage control mode, the values are measured directly on the female connector with sense leads connected at the measuring point and in current control mode directly at the output of the power supply.

Dynamic Voltage Deviation and Regulation Time

Voltage overshoot and undershoot occur in the case of abrupt load variations. See figure 1.
Causes of the voltage deviation (ΔV) are the energy stored in the output circuit and the limited speed of the regulator.
The regulation time (Δt) is defined as the time 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 1.
Values are measured directly on the female connector with sense leads connected at the measuring point.

Fig. 1
Voltage variation of the output when subjected to a defined sudden load variation



Applications

BUI / CUI V_{out} and I_{out} programmable

CE EMC + Safety tested

Changing the Mains Input Voltage to 115Vac

(Also see starting inrush current.)

Before changing the input voltage, the power supply has to be disconnected from the mains.
The units are set for 230Vac mains input voltage. To alter this voltage to 115Vac the bridges on the transformer should be switched according to figure 2. In addition the mains fuse Si. 1 should be replaced by one with double the current value (see techn. data).

Mains supply configuration of the various transformer sizes

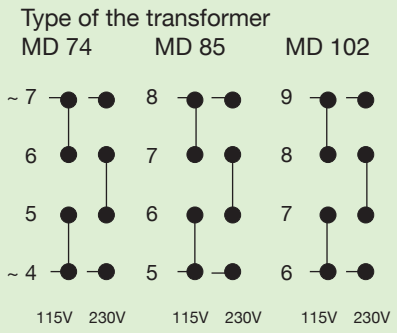


Fig. 2

Note: The type of the transformer can be recognised by the configuration of the pins.

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

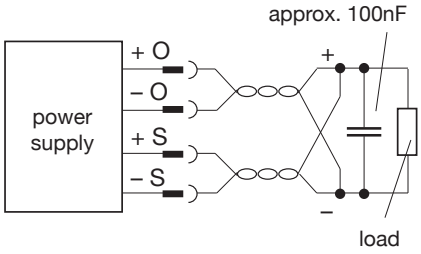
The power supplies are generally ready to operate even if sense leads are not connected.

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.



Operational State Indicator

LEDs positioned on the front indicate the current state of the unit.
a) green LED U-Const. lit = voltage control
b) green LED I-Const. lit = current control
If neither of the LEDs is lit, the unit is either
- not supplied with mains power or
- switched off by the integrated thermal protection.

Delivery Status - Stand-Alone

During stand-alone operation, the output voltage is controlled internally. The unit works like a fixed voltage controller with a set current limitation. The controlled output voltage as well as the maximum current are stated in the model designation.

Eg : CUI 60.1

V_{out} = 60V / I_{out} = 1A.

Stand-alone	Br.1	Br.2	Br.3	Br.4	Br.5	Br.6
V_{out} and I_{out} ; internally controlled		X	X	X	X	

X = bridged

Aeration

All power supplies circuits are intended for vertical installation. Therefore the cooling ribs of the mounted coolers have to run in the direction of aeration (from bottom to top). As all units are designed for convection cooling they must not be mounted in a closed case or in sub-racks with covers.
Sufficient air supply or, even better, forced ventilation (fan) must be ensured.
Please consult us about other applications.

Applications

BUI / CUI V_{out} and I_{out} programmable

Starting Inrush Current

The current surge is described through the current integral (see technical data).
The level of the maximum inrush current is limited by the internal resistance of the power supply, the cable resistance and the impedance of the mains.

Definition
To measure the inrush current, a network simulation is used with 0.5Ω (0.4Ω + j 0.25Ω). The mains cable has a length of 1m and a wire diameter of 2.5mm$^{2.}$

Note
The values on the data sheet for the inrush current increase when 115Vac input voltage is set. (See values of the techn. data.)

Use as a Current Source

The power supply is also suitable for use as a current source. In this operation mode the output current is controlled internally.
E.g. the CUI 60.1 under 0 to 60Ω can serve as a current source, which delivers 1A.
The desired output current should be set using the potentiometer “I SET” positioned on the front or programmed through the programming input.

Adjustment Ranges

The output voltage can be trimmed through the potentiometer "U-SET" between 90% and 110% of the nominal output voltage. The output current can be trimmed through the potentiometer "I-SET" from 0 to the nominal output current.

Safety Note V_{OUT} > 60V

In the case of a power supply with an output voltage above 60Vdc, the user must ensure that the output and load connections as well as the measurement configuration cannot be touched!

Voltage and Current Adjustable or Externally Programmed

These power supplies deliver a constant output voltage as well as a constant output current (source of current). The output voltage and output current can be programmed using external resistors as well as external voltage (0-10V). The power supply is protected against short circuits. The output voltage and the output current follow a VI-characteristic curve.
A general outline of the operating range is shown in figure 3.
In this power supplies the maximum output current is available at every output voltage.

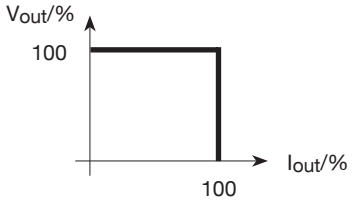


Fig. 3 VI-caracteristic curve

Applications

BUI / CUI V_{out} and I_{out} programmable

CE
EMC + Safety tested

Voltage Programming with External Voltage 0 - 10V (V_{set})

In this operation mode the output voltage must be programmed with an external programming voltage. The output voltage is proportional to the programming voltage: eg:

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

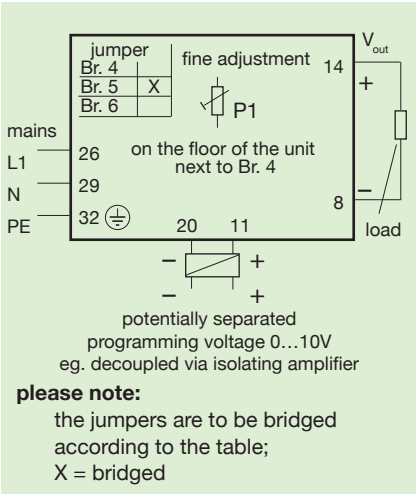
V_{set} = 5V ; V_{out} = 50% of $V_{out\ max}$

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

The programming input has an internal resistance of about 10kΩ.

Attention

The programming voltage must not exceed 10V, otherwise the programming input will be destroyed.



please note:
the jumpers are to be bridged according to the table;
X = bridged

Note

To be able to program the output voltage with external voltage, jumper 5 on the main circuit board should be connected. Jumpers 4 and 6 must be removed. The programming voltage must be connected to the multipoint plug H11 (see connector configuration).
Fine adjustment of the output voltage to the programming voltage can be carried out with the potentiometer P1.
Faults in the programming voltage are proportionally transferred to the output voltage of the power supply.
Twisting or screening the connection lines is necessary in order to largely rule out interference.

Voltage Programming with External Resistor (V_{set} R)

A programming resistor can be used as a further possibility for external programming. The output voltage is proportional to the programming resistor 1kΩ/V: eg :

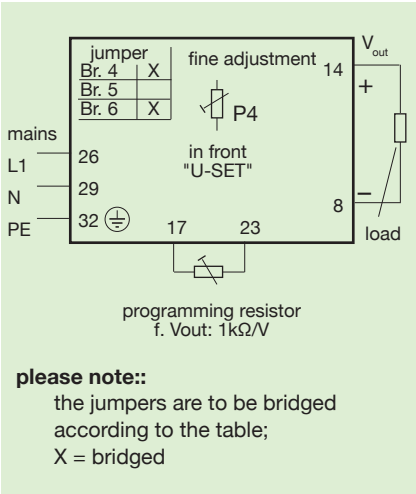
R_{set} = 0kΩ ; V_{out} = 0V

R_{set} = 10kΩ ; V_{out} = 10V

R_{set} = 15kΩ ; V_{out} = 15V

Attention

The programming resistor must not exeed 1kΩ•V_N (wire break >>1kΩ•V_N), otherwise the output voltage will be inflated.



please note::
the jumpers are to be bridged according to the table;
X = bridged

Note

Jumpers 4 and 6 on the main circuit board must be connected. Jumper 5 must be removed. The lines of the programming resistor must be connected to the multipoint connector H11 (see connector configuration).
The programmed output voltage can be adjusted to the programming resistor by using the setting potentiometer ”U SET” on the front (tolerance adjustment).
Twisting or screening the connection lines is necessary in order to largely rule out interference.

Applications

BUI / CUI V_{out} and I_{out} programmable

Current Programming with External Voltage (I_{set})

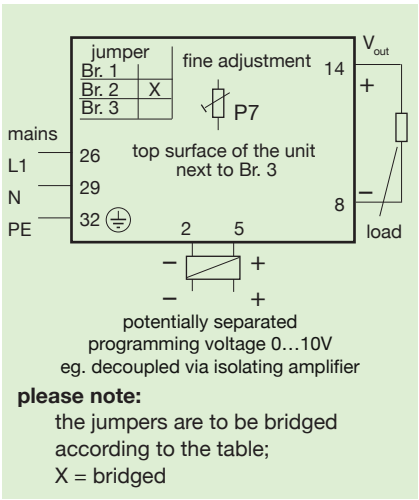
In this operation mode the output current must be programmed with an external programming voltage of 0 to 10V.
The output current is proportional to the programming voltage: eg:

V_{set} = 0V ; I_{out} = 0% of $I_{out\ max}$
V_{set} = 5V ; I_{out} = 50% of $I_{out\ max}$
V_{set} = 10V ; I_{out} = 100% of $I_{out\ max}$

The programming input has an internal resistor of about 10kΩ.

Attention

The programming voltage must not exceed 10V as otherwise the programming input will be destroyed.



please note:
the jumpers are to be bridged according to the table;
X = bridged

Note

To be able to program the current with external voltage, jumper 2 on the main circuit board must be connected. Jumpers 1 and 3 must be removed.
The programming voltage must be connected to the multipoint connector H11 (see connector configuration).
Fine adjustment of the output current to the programming voltage can be carried out with the potentiometer P7. P7 is located on the main circuit board next to Br. 3.
Faults in the programming voltage are proportionally translated onto the output current of the power supply.

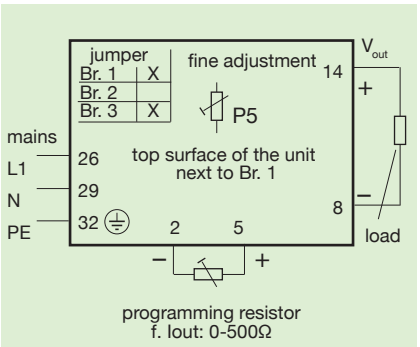
Current Programming with External Resistor (I_{set} R)

In this operation mode the output current must be programmed with an external programming resistor of 0 to 500Ω.
The output current is proportional to the programming resistor: eg:

R_{set} = 0Ω ; I_{out} = 0% $I_{out\ max}$
R_{set} = 250Ω ; I_{out} = 50% $I_{out\ max}$
R_{set} = 500Ω ; I_{out} = 100% $I_{out\ max}$

Attention

The programming resistor must not be greater than 500Ω (wire break >>500Ω) or else the current limitation of the unit will become ineffective and the unit will be destroyed.



please note::
the jumpers are to be bridged according to the table;
X = bridged

Note

To be able to program the current with external resistor, jumpers 1 and 3 on the main circuit board must be bridged. Jumper 2 must be removed.
The connecting lines of the programming resistor must be connected to the multipoint connector H11 (see connector configuration).
The output current can be tuned using the potentiometer P5 (main circuit board, from top) to the used programming resistor (tolerance adjustment).
Twisting or screening the connection lines is necessary in order to largely rule out interference.

Attention!

The external programming voltages V_{set} and I_{set} must be electrically separated from each other and from V_{out}. If no electrically separated voltages are available isolating amplifiers must be used. It is not permitted to inverse the polarity of the voltage at the programming inputs.
Maloperation leads to destruction of the power supply.

Temperature Coefficient

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

Thermal Switch-off

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

Circuiting Note

(positive/negative)

If, for example, one positive and one negative voltage with a common ground are required, all voltages can be connected ± freely with each other due to their separated potential.
However this should only happen at the load in order to exclude reciprocal control influence by various currents on the common ground.
This means: each voltage is wired separately up to the load and is not connected ± before this point.

Attention

Pay attention about the common ground of the programming voltage, it has to be potential-free.

Description Linearly Regulated Power Supplies

Mechanic, Environmental, Safety

BUI / CUI V_{out} and I_{out} programmable

CE
EMC + Safety tested

Mechanical System

Kniel linearly regulated 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 neighbouring module in the subrack, ensuring adequate convection cooling up to the maximum permitted ambient temperature (see technical data). 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

BUI / CUI V_{out} and I_{out} programmable

Electrical Safety

Kniel linearly regulated 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 for:

0V < V_{out} ≤ 60V		
primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	700 Vdc
60V < V_{out} ≤ 100V		
primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	1 200 Vdc
100V < V_{out} ≤ 300V		
primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	2 000 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 con-sideration. This includes, for instance, domestic electrical appliances. Overvoltages resulting from switching operations must be taken into consideration.

Definition of the Safety Class

The linear regulators are built to safety class I. In this safety class all parts which can be touched must be connected with the PE with low impedance. 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 are clearly less this value.
Between 45 and 66Hz frequency of the mains, they meet the limits for hand-held equipment of ≤ 750µA.

More Tests

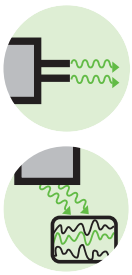
A fire resistance test, an overload test and a test of mechanical load capability are also conducted according to EN 60950/IEC 950.
A test designated "operation not as intended and incorrect operation" is conducted in order to allow us to assess the risks and dangers if the unit is operated not as intended.

CE
EMC + Safety tested

EMC

The linearly regulated 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)



The high-frequency interference level is very low in linear controllers. Interference can only occur through mains rectification.
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 linearly regulated power supplies are used on residential or commercial premises or in public facilities. See figure 4 and figure 5.
The limiting values for industrial applications are defined in EN 55011.

Fig. 4
Limit value class
150KHz to 30MHz

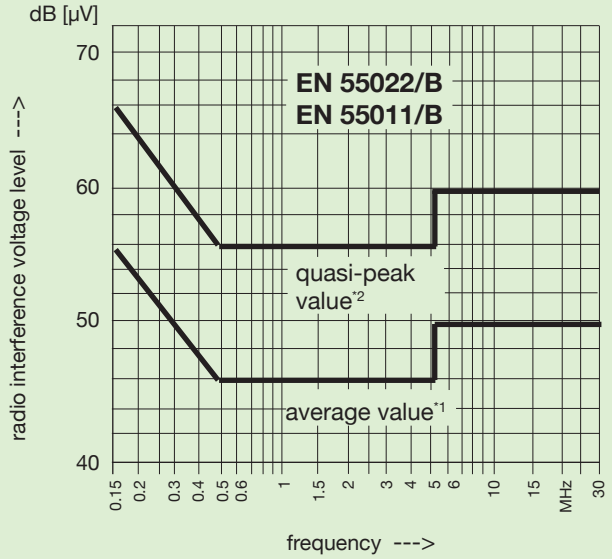
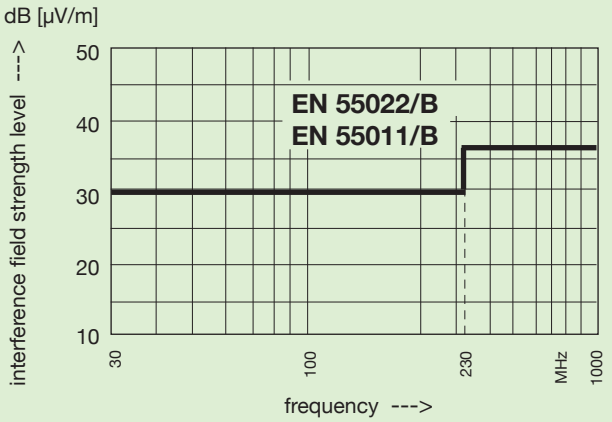


Fig. 5
Limit value class
30MHz to 1 000MHz



*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 Linearly Regulated Power Supplies

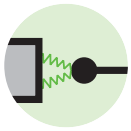
EMC

BUI / CUI V_{out} and I_{out} programmable

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.
For Kniel linear regulators the threshold values are based on EN/IEC 61000-6-2 (industrial application).

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

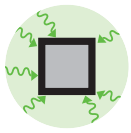


This test verifies the immunity to electrostatic discharge as may occur from the operator's body when touching the equipment. Static discharges as can result between different objects are also covered by this test.
The required test voltage is:

8 kV - discharge in air
4 kV - contact discharge

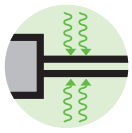
Evaluation criterion B.
Kniel linear regulators meet evaluation criterion A.

Immunity to Electro-Magnetic Fields According to EN/IEC 61000-4-3



Interference immunity can be attained in the entire system by appropriate protective measures. For example by installation in a closed housing.

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

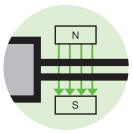


Fast transient bursts occur during switching operations, e.g. disconnecting inductive loads and bounce of relay contacts, in all electrical power supply systems.
The burst test is intended to guarantee that the function of electrical loads is not impaired on a sustained basis as the result of these extremely brief voltage peaks.
The standard requires:
Evaluation criterion B.
Kniel linear regulators meet evaluation criterion A.

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

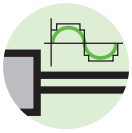
Interference immunity can be attained in the entire system by appropriate protective measures. For example by installation of additional filters.

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 linear regulators meet evaluation criterion A.

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.

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.