Description Linearly Regulated Power Supplies

Definition of the Output Data

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

Voltage Deviation in the Event of a Variation in Load (static)

Depending on the current load, there is a slight change in the voltage, the so-called control deviation, on all voltage regulators used.
It is specified in the data sheets as the maximum magnitude of a load variation of 0...100% of the nominal current.
Measurement is conducted directly on the female connector with sense leads connected at the measuring point.

Voltage Deviation in the Event of a Variation in the Mains

If the mains is varied, the output voltage will also vary slightly.
The data sheets specify the maximum system deviation of the output voltage caused by a change of the mains between $V_{IN\ min}$ and $V_{IN\ max}$.
Values are measured directly on the female connector with sense leads connected at the measuring point.

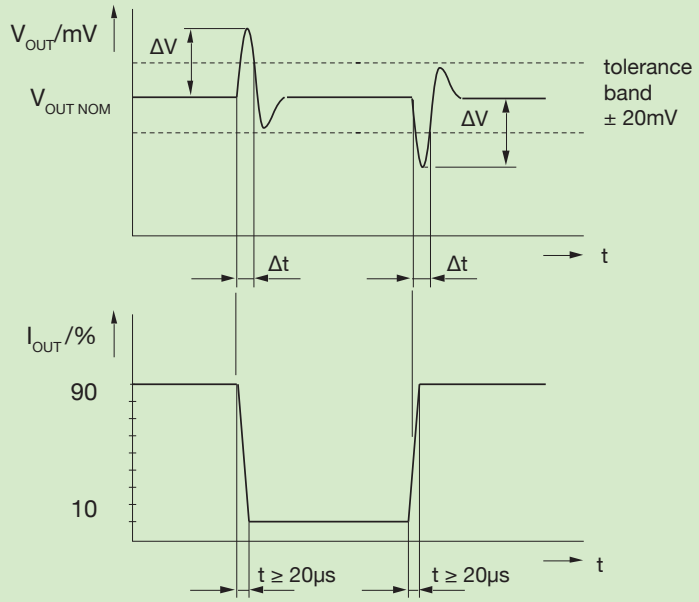
Residual Ripple (100Hz)

When rectifying the 50Hz AC voltage, a 100Hz superimposition on the DC voltage results.
This 100Hz ripple is measurable as a residual ripple on the output voltage.
Values are measured directly on the female connector with sense leads connected at the measuring point.

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

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

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 even if no sense leads are connected.

Sense leads

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

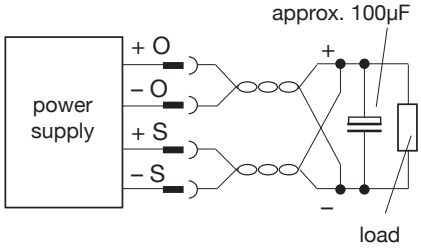
External bridges do not have to be wired.

In many practical applications, the devices are operated without sense leads being connected. E.g. in the case of short (low impedance) load lines or low load alternation.

The actual value of the voltage is measured directly at the load through the sense leads. Voltage drops through connectors and load lines are automatically compensated by the electronic regulation circuit. The stabilisation is designed for the value specified in the data sheet per load line.

To this end no changes are to be made to the power supply itself. Only the sense leads are externally connected to the load lines directly at the load.

The load lines may not be disconnected before the sense leads, or the sense leads may not be connected before the load lines, as this will lead to the destruction of the device.



Changing the Mains Input Voltage to 115Vac

(See also 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.

Mains supply configuration of the various transformer sizes.

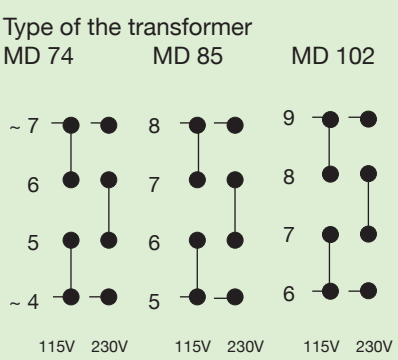


Fig. 2

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

Aeration (BUF, WBUF, CHV)

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.

Aeration (CL, CLO, CLD, CLDO)

The power supplies of the series CL, CLO, CLD, CLDO are designed for strong forced ventilation (about 3m/s) in a vertical assenbly. This means: forced ventilation must be provided and the slotted perforated plates should be at the top and bottom.

If the forced ventilation fails, an integrated thermal safeguard electronically switches off the equipment.

After cooling down, the power supply automatically switches itself on again.

Applications

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

Starting Inrush Current (BUF, WBUF, CHV)

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 data sheets.)

Starting Inrush Current (CL, CLO, CLD, CLDO)

To limit the inrush current, the power supply features an 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 power supply again immediately after switching it off.
The current surge is described through the current integral (see technical data: "unit cold" and "worst case").
The level of the maximum inrush current is limited by the internal resistance of the power supply, the main 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

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 ≤ 25°C for approx. 5 minutes.

Extern ON/OFF (CL, CLO, CLD, CLDO)

Power supplies of the series CL, CLO, CLD, CLDO can be switched on or off using external control voltage or an external contact.
External control voltage and external contact can be selected by means of jumpers inside the unit.
The top cover plate should be removed for this purpose. The jumpers are easily accessible at the edge of the printed circuit board immediately next to the H15 multipoint connector (CLD, CLDO) or the front panel (CL, CLO).
The jumpers are labelled BR. 1, BR. 2 and BR. 3.

- Function with external voltage:
  BR. 1 connected = factory setting.

Voltage Level at the Extern ON/OFF-Input		
Unit ON	≤ 0.6V or not connected	
Unit OFF	≥ 4V to max. 18V	
	CL/CLO	CLD/CLDO
$V_{I/O}$ = 5 V	$I_{I/O}$ ≤ 3.5 mA	$I_{I/O}$ ≤ 4.0 mA
$V_{I/O}$ =10 V	$I_{I/O}$ ≤ 9.0 mA	$I_{I/O}$ ≤ 11 mA
$V_{I/O}$ =18 V	$I_{I/O}$ ≤ 18 mA	$I_{I/O}$ ≤ 22 mA

(Potential-free optocouplerinput; near to secondary potential.)

- Function with external contact:
  BR. 2 and BR. 3 connected.

Connections at the H15 connector
series CL, CLO pin 18 and pin 20
series CLD, CLDO pin 12 and pin 14

external contact
open = unit "ON"

external contact
closed = unit "OFF"

(A potential-free contact is neccessary.)

Maximum contact load:
CL, CLO ≤ 10mA
CLD, CLDO ≤ 18mA
at V_{max} = 21V

After an external shut-down function, due to the circuitry, low energy residual voltage of ≤ 0.6V remains at the outputs of the dual voltage units.

Extern ON/OFF (BUF, WBUF, CHV)

Power supplies of the series BUF, WBUF, CHV can be switched on or off using an external control voltage.

Voltage Level at the Extern ON/OFF-Input	
Unit ON	≤ 0.6V or not connected
Unit OFF	≥ 4V to max. 18V
$V_{I/O}$ = 5V	$I_{I/O}$ ≤ 3.5 mA
$V_{I/O}$ = 10V	$I_{I/O}$ ≤ 9.0 mA
$V_{I/O}$ = 18V	$I_{I/O}$ ≤ 18.0 mA

The control voltage input has enough isolation to the output.

Parallel Connection (BUF, WBUF)

Unit versions equipped with a PA connection can be connected in parallel.
Maximum 3 units may be operated in parallel in order to increase the power.
The individual PA contacts must be interconnected for this purpose so that the overvoltage protection circuit (output) integrated in the unit also switches off the power supplies operated in parallel in the event of a fault.
The load leads + and - should be interconnected in as balanced a manner as possible.
We recommend redundancy operation in order to achieve even greater reliability. A connection in parallel is not recommended for multiple voltage units.

Parallel Connection (CHV, CL, CLO, CLD, CLDO)

Parallel connection is only recommended under certain circumstances. Linearly regulated power supplies controllers as a larger power class is the better solution.
If parallel connection becomes necessary in the largest power classes, we recommend only to provide parallel connection for equipment without overvoltage protection.
For equipment with overvoltage protection, redundant connection by means of decoupling diodes is recommended. If at some point parallel connection still becomes inevitable, please contact us.

Description Linearly Regulated Power Supplies

Applications

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

CE
EMC + Safety tested

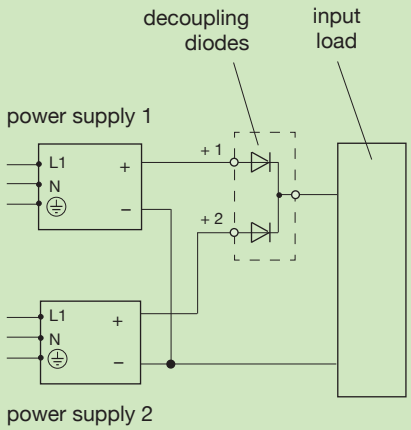
Electrical Isolation

On Kniel primary switched power supplies, all inputs and outputs are electrically isolated. This means that the outputs can be freely interconnected.

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. See figure 3.
In this operating mode, sense lead operation is impossible.

Fig. 3



Safety note
V_{out} > 60V

For unit versions above 60Vdc, the user must ensure that the output and load connections as well as the measurement configuration cannot be touched!

Current Limitation

All outputs are protected from overloading by an installed current limiting circuit and are permanently protected from short circuits.
Current limitation is factory-set to the values specified in the technical data. If the adjusted limit value is exceeded, the output current is limited to the fold back value and the voltage decreased according to the size of the overload. The unit automatically returns to voltage control after the fault has been eliminated.
Also see thermal switch-off.

Temperature Coefficient

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

Thermal Switch-off

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

Overvoltage Protection (Output)

In units with overvoltage protection, the connected electronics are protected from unacceptably high voltages.
If an internal or external overvoltage is detected at the output of the power supply, a thyristor ignites and short-circuits the output.
In the case of external faults, the power supply can be reactivated by switching the supply voltage off and on (mains reset), if the external fault has been eliminated.
The factory setting of the response thresholds depends on the individual type of unit and the level of the output voltage (see technical data).

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.

For safety reasons the common ground has to be earthed for output voltages higher than 30Vdc !

Should other interconnections get necessary, please contact us.

Description Linearly Regulated Power Supplies

Mechanic, Environmental, Safety

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

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 20 according to
EN 60529/IEC 529

Degree of protection (for 19" units):
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.

Description Linearly Regulated Power Supplies

Safety

BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

CE
EMC + Safety tested

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
secondary	- secondary	700 Vdc

60V < V_{out} ≤ 100V

primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	1 200 Vdc
secondary	- secondary	700 Vdc

100V < V_{out} ≤ 300V

primary	- secondary	4 250 Vdc
primary	- PE	2 150 Vdc
secondary	- PE	2 000 Vdc
secondary	- secondary	700 Vdc.

Note

On no account do we recommend a repeat test by the customer according to EN 60950/IEC 950 since this could damage semiconductors and insulation. If a further high-voltage test on each unit is mandatory, the test conditions must be coordinated with Kniel. Otherwise, we are unable to accept warranty.

SELV

Kniel power supplies with an output voltage of max. 55Vdc keeps to the requirements of SELV circuits.
SELV circuits need a surely electric isolation to the mains.

Definition of the Ambient Conditions According to EN 60950/IEC 950

Pollution Severity II

Only non-conductive pollution occurs. Temporary conductivity as the result of condensation must be anticipated occasionally.

Overvoltage Category II

Equipment of overvoltage category II is intended for use in installations or parts thereof in which lightning overvoltage does not need to be taken into 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.

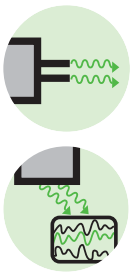
More Tests

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.

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

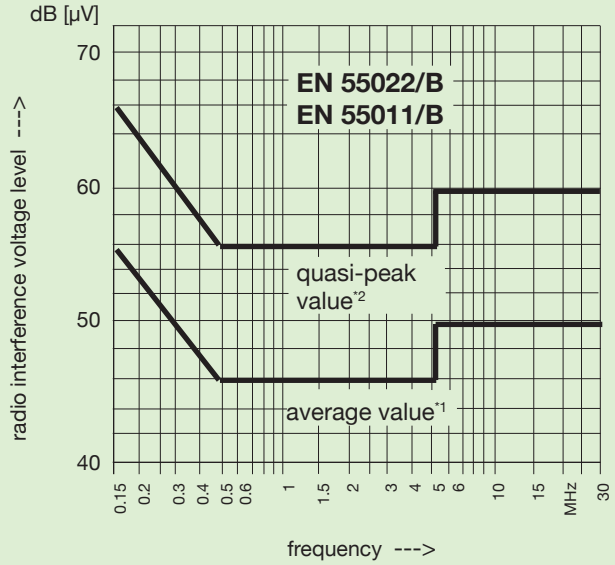
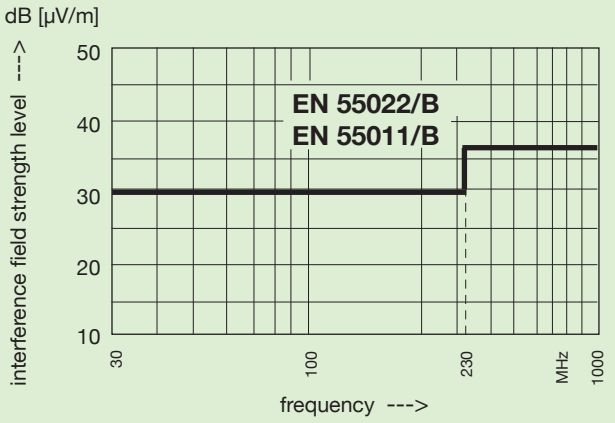


Fig. 5
Limit value class
30MHz to 1 000MHz



*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

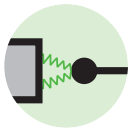
BUF, WBUF, CHV, CL, CLO, CLD, CLDO, CD (V_{out} > 30V)

CE
EMC + Safety tested

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

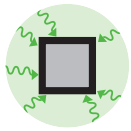


This test verifies the immunity to electrostatic discharge as may occur from the operator's body when touching the equipment. Static discharges as can result between different objects are also covered by this test.
The required test voltage is:

8 kV - discharge in air
4 kV - contact discharge

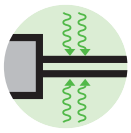
Evaluation criterion B.
Kniel linear regulators meet evaluation criterion A.

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.

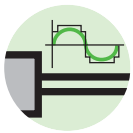
The standard requires:

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.

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.