5. AC-INPUT

AC input	nom.	AC 100-240V	wide-range input, TN-, TT-, IT-Mains, see **Fig. 5-1**
AC input range	min.	85-276Vac	continuous operation
	min.	60-85Vac	full power for 200ms, no damage between 0 and 85Vac
	min.	276-300Vac	< 500ms
Input frequency	nom.	50 – 60Hz	±6%
Turn-on voltage	typ.	77Vac	steady-state value, see **Fig. 5-1**
Shut-down voltage	typ.	73Vac	steady-state value, see **Fig. 5-1**
	typ.	53Vac	dynamical value

		AC 100V	**AC 120V**	**AC 230V**	
Input current	typ.	5.47A	4.56A	2.48A	at 24V, 20A, see **Fig. 5-3**
Power factor *)	typ.	0.96	0.95	0.90	at 24V, 20A, see **Fig. 5-4**
Crest factor **)	typ.	1.6	1.7	2.05	at 24V, 20A
Start-up delay	typ.	640ms	610ms	660ms	see **Fig. 5-2**
Rise time	typ.	80ms	80ms	80ms	0mF, 24V, 20A, see **Fig. 5-2**
	typ.	85ms	85ms	85ms	20mF, 24V, 20A, see **Fig. 5-2**
Turn-on overshoot	max.	50mV	50mV	50mV	see **Fig. 5-2**

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.
**) The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.

Fig. 5-1 **Input voltage range**

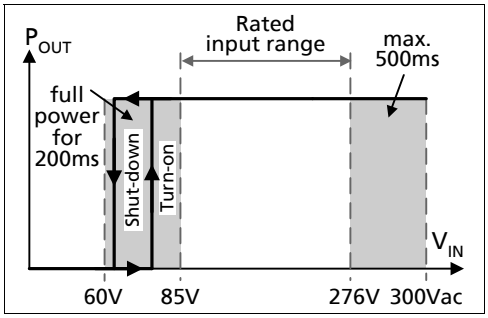


Fig. 5-2 **Turn-on behavior, definitions**

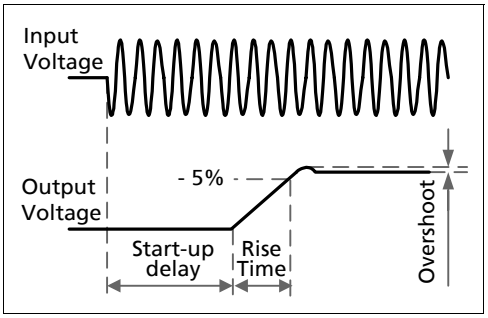


Fig. 5-3 **Input current vs. output load at 24V**

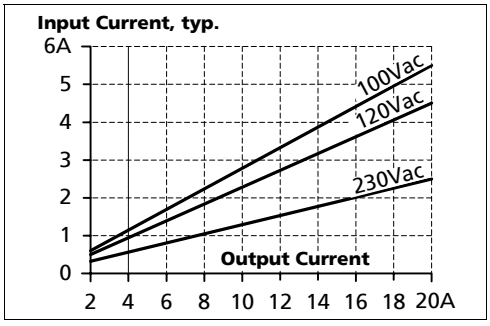
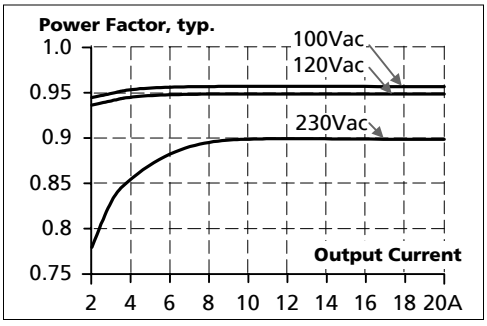


Fig. 5-4 **Power factor vs. output load at 24V**

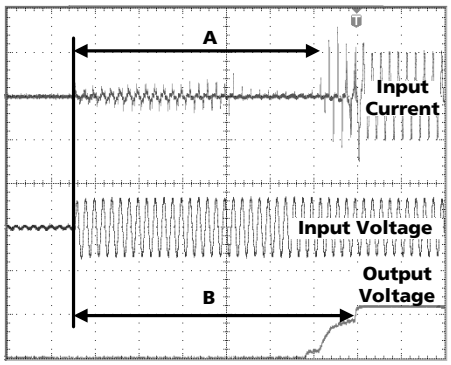


6. INPUT INRUSH CURRENT

An active inrush limitation circuitry limits the input inrush current after turn-on of the input voltage.
The charging current into EMI suppression capacitors is disregarded in the first millisecond after switch-on (EN 61204).

		AC 100V	AC 120V	AC 230V	
Inrush current	max.	$13A_{peak}$	$13A_{peak}$	$13A_{peak}$	-25°C to +70°C, mains interruptions > 750ms
	typ.	$11A_{peak}$	$9A_{peak}$	$7A_{peak}$	-25°C to +70°C, mains interruptions > 750ms
Inrush energy	max.	$5A^2s$	$5A^2s$	$5A^2s$	-25°C to +70°C, mains interruptions > 750ms
Inrush delay	typ.	400ms	400ms	650ms	

Fig. 6-1 **Input inrush current, typical behavior**



A: Inrush delay
B: Start-up delay

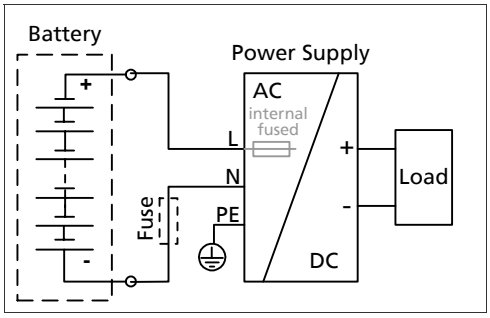
Input: 230Vac
Output: 24V, 20A
Ambient: 25°C

Upper curve: Input current 5A / DIV
Medium curve: Input voltage 500V / DIV
Lower curve: Output voltage 20V / DIV
Time basis: 100ms / DIV

7. DC-INPUT

DC input	nom.	DC 110-300V	
DC input range	min.	88-375Vdc	continuous operation
DC input current	typ.	4.7A / 1.7A	110Vdc / 300Vdc, 24V, 20A
Turn-on voltage	typ.	74Vdc	steady state value
Shut-down voltage	typ.	69Vdc	steady state value

Fig. 7-1 **Wiring for DC Input**



Instructions for DC use:

a) Use a battery or similar DC source.
b) Connect +pole to L and –pole to N.
c) Connect the PE terminal to an earth wire or to the machine ground.

In case the –pole of the battery is not connected to earth, use an appropriate fuse to protect the N terminal.

8. OUTPUT

Output voltage	nom.	24V	
Adjustment range	min.	24-28V	guaranteed, multi turn potentiometer
	max.	30V	at clockwise end position of potentiometer
Factory setting		24.1V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	60 to 300Vac
Load regulation	max.	100mV	static value, 0A → 20A → 0A
Ripple and noise voltage	max.	100mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	8 500µF	

Continuous power capability

Output current	nom.	20A	at 24V, see Fig. 8-1
	nom.	17A	at 28V, see Fig. 8-1
Output power	nom.	480W	24V, continuous
	nom.	480W	28V, continuous
Short-circuit current	min.	30A	load impedance 50mOhm, up to 4s before hiccup mode starts, see Fig. 8-1 and Fig. 8-3
	max.	40A	

BonusPower®, short term power capability (up to typ. 4s)

The power supply is designed to support loads with a higher short-term power requirement without damage or shutdown. The short-term duration is hardware controlled by an output power manager. This BonusPower® is repeatedly available. Detailed information can be found in chapter 27.1. If the power supply is loaded longer with the BonusPower® than shown in the Bonus-time diagram (see Fig. 8-2), the max. output power is automatically reduced to 480W.

If the power requirement is continuously above 480W and the voltage falls below approx. 20V (due to the current regulating mode at overload), the unit shuts-off and makes periodical restart attempts. This behavior is called hiccup mode which is described below. If the voltage is above 20V, the unit continuously delivers current.

Hiccup Mode:

Up to 4s of overloading, the power supply delivers continuous output current. After this, the output power is reduced to nearly zero for approx. 17s before a new start attempt is automatically performed. If the overload has been cleared, the device will operate normally. If the overload still exists, the output current will be delivered for 2 to 4s (depending on the overload) again followed by a17 s rest time. This cycle is repeated as long as the overload exists. See Fig. 8-3. During the off-period a small rest voltage and rest current is present on the output.

Output current	nom.	30A	at 24V, see Fig. 8-1
	nom.	26A	at 28V, see Fig. 8-1
Output power	nom.	720W	24V, short term
	nom.	720W	28V, short term
Short-circuit current	min.	30A	load impedance 50mOhm, up to 4s, see Fig. 8-1
	max.	40A	load impedance 50mOhm, up to 4s, see Fig. 8-1
Bonus time	typ.	4s	at 24V, 30A, duration until the output voltage dips, see Fig. 8-2
	min	3.5s	
	max.	4.5s	

Fig. 8-1 **Output voltage vs. output current, typ.**

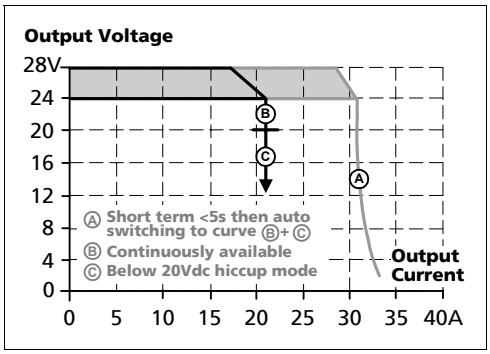


Fig. 8-2 **Bonus time vs. output power**

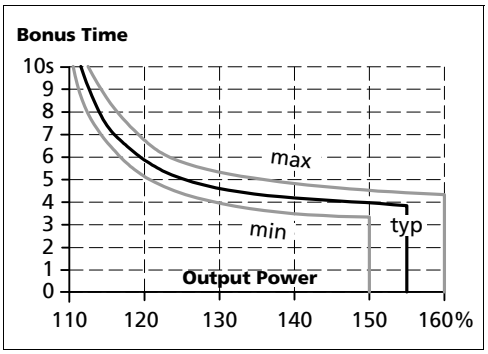
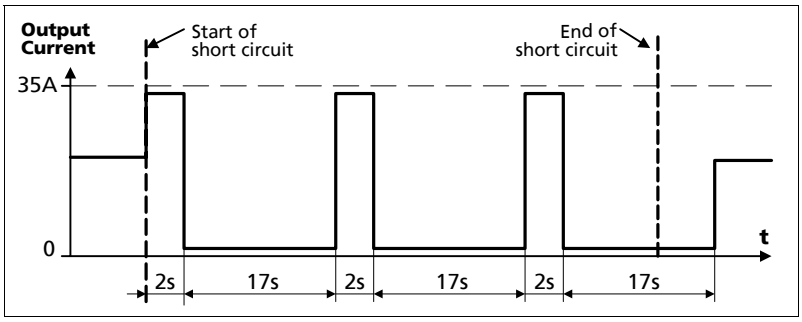


Fig. 8-3 **Short-circuit on output, hiccup mode, typical behavior**



The Bonus Power® is available as soon as power comes on and immediately after the end of an output short circuit or output overload.

Fig. 8-4 **BonusPower® after input turn-on**

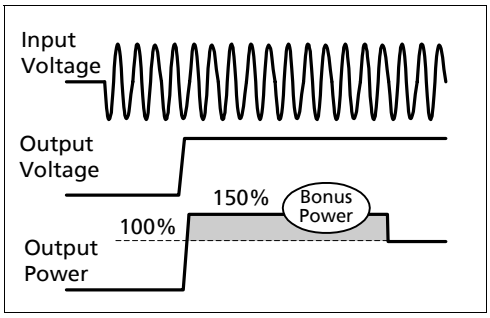
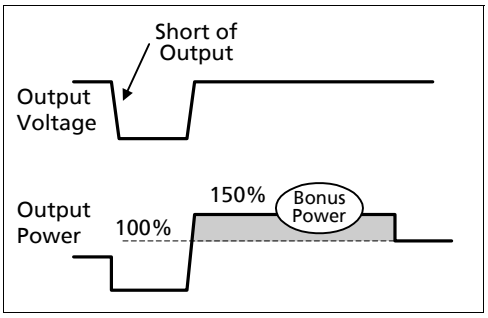


Fig. 8-5 **BonusPower® after output short**



Peak current capability (up to several ms)

The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 27.2.

Peak current voltage dips	typ.	from 24V to 19V	at 40A for 20ms
	typ.	from 24V to 18V	at 80A for 2ms
	typ.	from 24V to 17.5V	at 80A for 5ms

9. HOLD-UP TIME

		AC 100V	AC 120V	AC 230V	
Hold-up Time	typ.	32ms	32ms	51ms	20A, 24V, see **Fig. 9-1**
	typ.	64ms	64ms	99ms	10A, 24V, see **Fig. 9-1**

Fig. 9-1 **Hold-up time vs. input voltage**

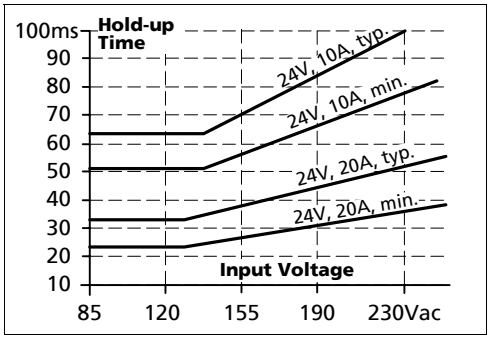
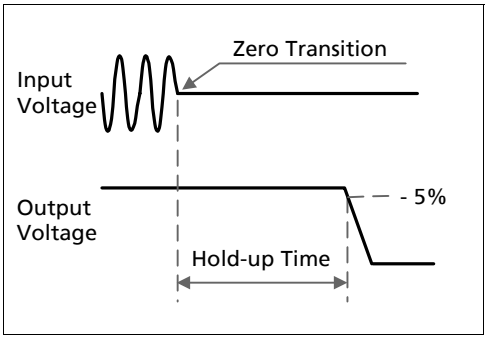


Fig. 9-2 **Shut-down behavior, definitions**

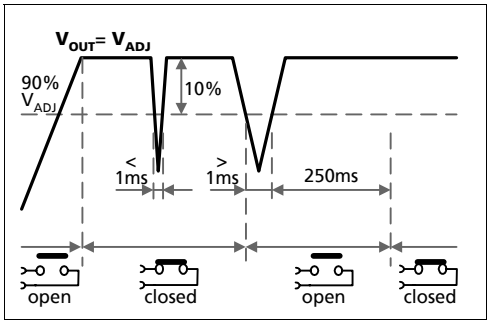


10. DC-OK RELAY CONTACT

This feature monitors the output voltage, which is produced by the power supply itself. It is independent of a back-fed voltage from a unit which is connected in parallel to the power supply output.

Contact closes	As soon as the output voltage reaches the adjusted output voltage.		
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 250ms. Dips shorter than 1ms will be ignored.		
Contact re-closes	As soon as the output voltage exceeds 90% of the adjusted voltage.		
Contact ratings	max	60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A	resistive load
	min	1mA at 5Vdc	min. permissible load
Isolation voltage	See dielectric strength table in section 20		

Fig. 10-1 **DC-ok relay contact behavior**



Note:
The DC-ok feature requires that the output voltage reaches the nominal (=adjusted) level after turn-on in order to function according to specification. If this level cannot be achieved, the overload LED will be on and the DC-ok contact will be open. The overload signal will only shut off as soon as the adjusted voltage is reached. This is an important condition to consider particularly, if the load is a battery, the power supply is used in parallel or the power supply is used for N+1 redundant systems.

Restrictions apply when using the DC-OK Contact in a Haz-Loc environment:

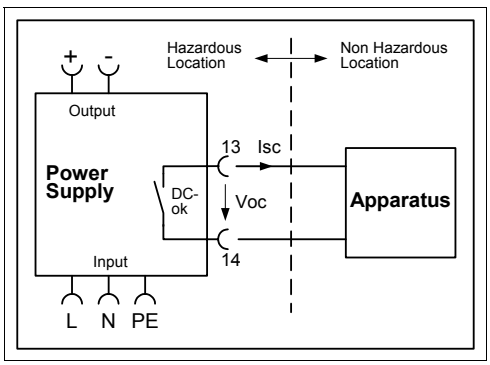
The DC-OK contact is intended to be used for a separately investigated nonincendive field wiring and/or field wiring apparatus. The apparatus may be located in a Class I, Division 2 (Group A, B, C or D) hazardous (classified) location.

Non associated nonincendive field wiring apparatus shall not be connected in parallel unless this is permitted by the associated nonincendive field wiring apparatus approval.

Selected barriers must have entity parameters such that Voc < V max, Isc < I max, Ca > Ci + Ccable, La > Li + Lcable.

For Ccable and Lcable, if the capacitance per foot or the inductance per foot is not known, then the following values shall be used: Ccable = 60pF/foot and Lcable = 0.2uH/foot.

Fig. 10-2 **DC-ok control drawing for use in Haz-Loc environments**



Contact current: I max = 50mA,
Contact voltage: V max. = 35V (DC or AC)
Max. associated circuit capacitance Ca = 100nF
Max. associated circuit inductance La = 20mH
No polarity requirement

11. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	91.6%	92.4%	93.9%	20A, 24V
Power losses	typ.	44.0W	39.6W	31.4W	20A, 24V
	typ.	9.0W	9.2W	10.0W	0A

Fig. 11-1 **Efficiency vs. output current at 24V**

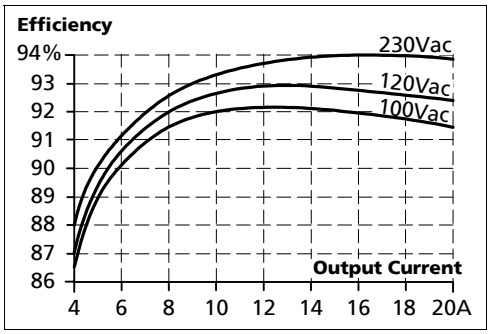


Fig. 11-2 **Losses vs. output current at 24V**

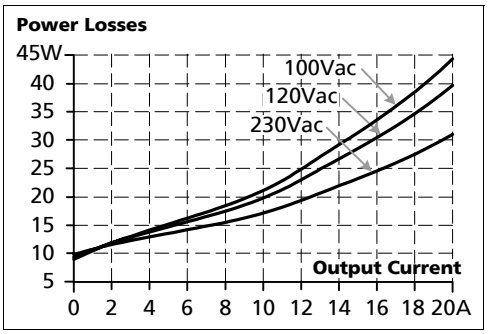


Fig. 11-3 **Efficiency vs. input voltage, 24V, 20A**

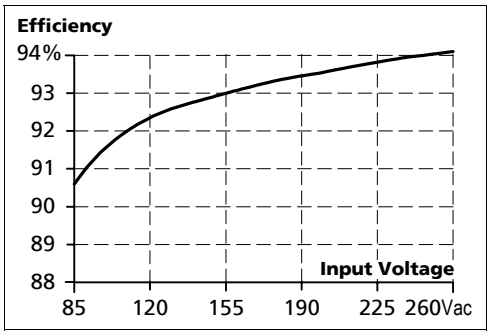


Fig. 11-4 **Losses vs. input voltage, 24V, 20A**