5. INPUT VOLTAGE

Input	nom.	DC 24V	
Input voltage range	nom.	18.0-32.4Vdc	Continuous operation
		14.0-18.0Vdc	Max. 60 seconds or with de-rating, see Fig. 5-2
	max.	36.0Vdc	Absolute maximum continuous input voltage with no damage to the DC/DC converter.
Allowed voltage between input and earth (ground)	max.	60Vdc or 42.4Vac	
Allowed input ripple voltage	max.	5Vpp	47Hz-40kHz, the momentary input voltage must always be within the specified limits.
Turn-on voltage	typ.	17.5Vdc	Steady-state value, see Fig. 5-1
Shut-down voltage	typ.	14.0Vdc	Steady-state value, see Fig. 5-1
	typ.	35Vdc	Steady-state value, see Fig. 5-1
Input current	typ.	4.6A	At 24Vdc input and output 12V, 8A, see Fig. 5-4
Start-up delay	typ.	420ms	See Fig. 5-3
Rise time	typ.	210ms	0mF, 12V, 8A constant current load, see Fig. 5-3
	typ.	240ms	8mF, 12V, 8A constant current load, see Fig. 5-3
Turn-on overshoot	max.	500mV	See Fig. 5-3
Input capacitance	typ.	3000µF	

External capacitors on the input voltage bus are allowed without any limitations.

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

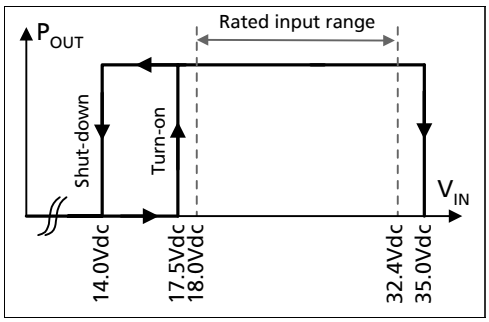


Fig. 5-2 **Allowable output current below 18V input voltage**

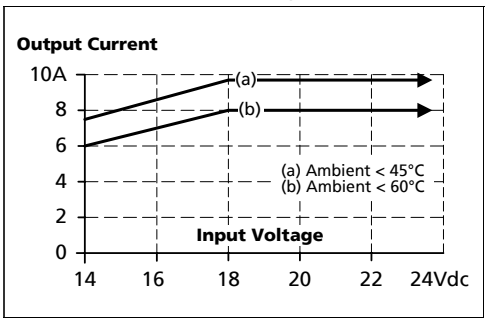


Fig. 5-3 **Turn-on behavior, definitions**

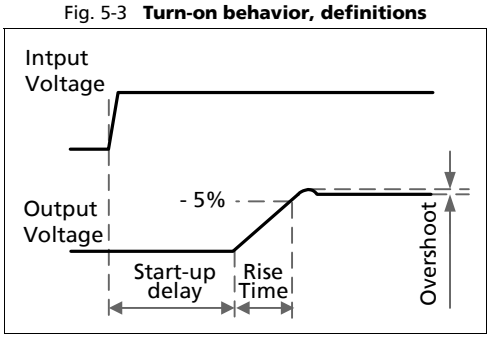
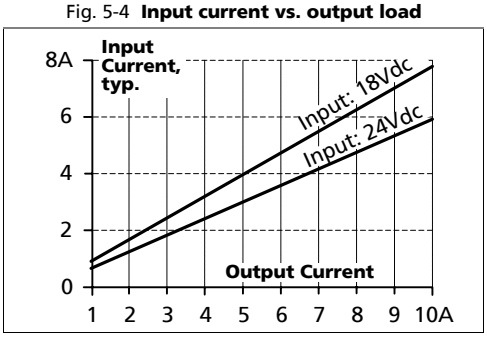


Fig. 5-4 **Input current vs. output load**



6. SOFT-START AND INPUT INRUSH CURRENT SURGE

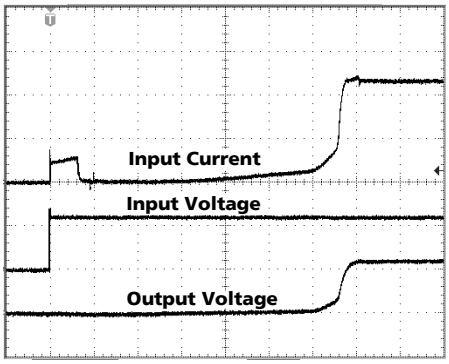
Inrush current limitation

An active inrush limitation circuit (inrush limiting resistor which is bypassed by a relay contact) limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		Input 24Vdc	
Inrush current	max.	$1.6A_{peak}$	-25°C to +70°C
	typ.	$1.2A_{peak}$	-25°C to +70°C
Inrush energy	typ.	negligible	-25°C to +70°C

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



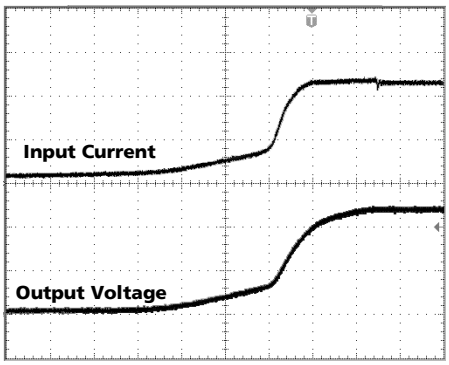
Input: 24Vdc
Output: 12Vdc, 8A, constant current load
Ambient: 25°C

Upper curve: Input current 2A / DIV
Middle curve: Input voltage 20V / DIV
Lower curve: Output voltage 10V / DIV
Time scale: 100ms / DIV

Soft-start function:

After the DC/DC converter is turned on, the internal output current rises slowly to its nominal value. This method charges the output capacitors (internal and external capacitors) slowly and avoids high input currents during turn-on. High input currents can produce a high voltage drop on the input wiring (especially with long and thin cables) which reduces the terminal voltage on the DC/DC converter. If the terminal voltage is below the shut-down voltage, the DC/DC converter will turn-off and will make a new start-up attempt. This effect is avoided with the integrated soft-start function. Please note, that this function increases the rise time of the output voltage by a small amount.

Fig. 6-2 **Soft-start behavior**



Input: 24Vdc
Output: 24Vdc, 5A, constant current load
Ambient: 25°C
No additional external capacitors

Upper curve: Input current 2A / DIV
Lower curve: Output voltage 5V / DIV
Time scale: 20ms / DIV

7. OUTPUT

Output voltage	nom.	12V	
Adjustment range	min.	12-15V	Guaranteed
	max.	16.1V	At clockwise end position of potentiometer
Factory setting		12.0V	±0.2%, at full load, cold unit
Line regulation	max.	25mV	Input variations between 18 to 32.4Vdc
Load regulation	max.	120mV	Static value, 0A → 8A → 0A
Ripple and noise voltage	max.	75mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	6500µF	
Output current	nom.	9.6A	At 12V, ambient < 45°C, see **Fig. 7-1**
	nom.	8A	At 12V, ambient < 60°C, see **Fig. 7-1**
	nom.	7.7A	At 15V, ambient < 45°C, see **Fig. 7-1**
	nom.	6.4A	At 15V, ambient < 60°C, see **Fig. 7-1**
Output power	nom.	115W	Ambient < 45°C
	nom.	96W	Ambient < 60°C
Short-circuit current	min.	14A	Load impedance 150mOhm, see **Fig. 7-1**
	max.	18A	Load impedance 150mOhm, see **Fig. 7-1**

Fig. 7-1 **Output voltage vs. output current, typ. (24Vdc input voltage)**

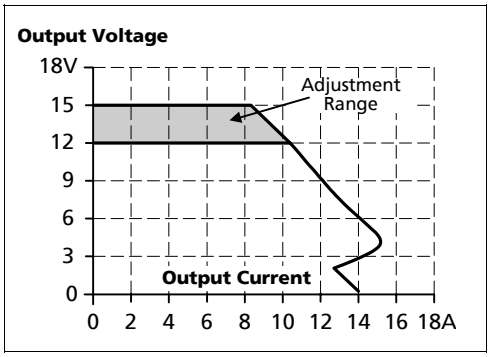
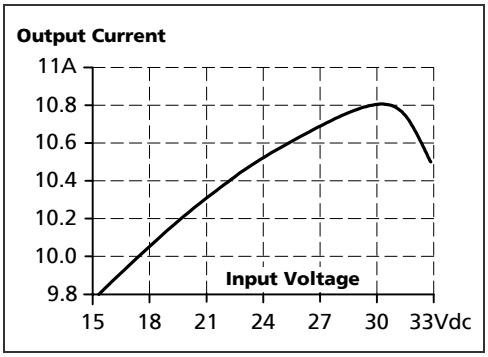


Fig. 7-2 **Current limitation vs. input voltage, typ. (11.5V constant voltage load)**



Peak current capability (up to several ms)

The DC/DC converter 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 DC/DC converter. During this event, the capacitors will be discharged and cause a voltage dip on the output. Detailed curves can be found in chapter 25.1.

Peak current voltage dips	typ.	from 12V to 8.3V	At 16A for 50ms, resistive load
	typ.	from 12V to 6.2V	At 40A for 2ms, resistive load
	typ.	from 12V to 4.3V	At 40A for 5ms, resistive load

8. HOLD-UP TIME

The input side of the DC/DC converter is equipped with a bulk capacitor which keeps the output voltage alive for a certain period of time when the input voltage dips or is removed. The bulk capacitor can be discharged by loading the DC/DC converter on the output side or through a load which is parallel to the input. There is no protection in the DC/DC converter which prevents current from flowing back to the input terminals. If prevention is needed, an external diode should be used.

		Input 24Vdc	
Hold-up Time	typ.	12.8ms	Input 24Vdc, Output: 12Vdc, 4A, see **Fig. 8-1**
	typ.	7ms	Input 24Vdc, Output: 12Vdc, 8A, see **Fig. 8-1**

Fig. 8-1 **Hold-up time vs. input voltage**

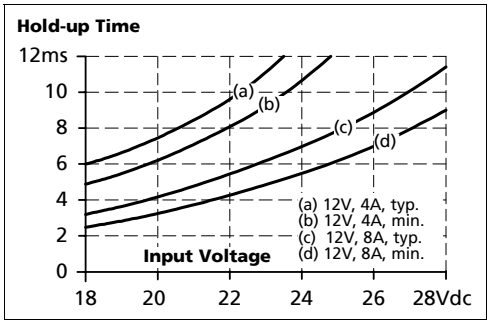


Fig. 8-2 **Shut-down test setup**

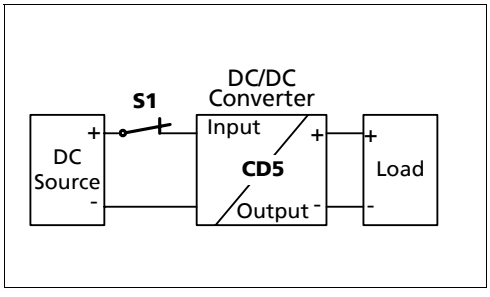
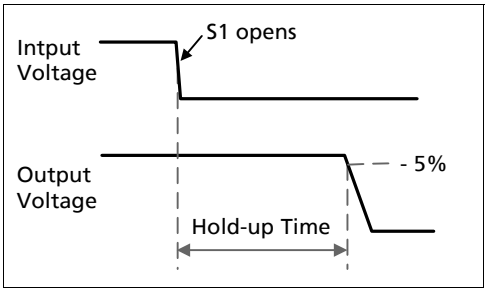


Fig. 8-3 **Shut-down behavior, definitions**



Note: At no load, the hold-up time can be up to several seconds. The green DC-ok lamp is also on during this time.

9. Efficiency and Power Losses

		Input 24Vdc	
Efficiency	typ.	88.2%	8A, 12V
Power losses	typ.	0.6W	At no output load
	typ.	6.4W	4A, 12V
	typ.	12.8W	8A, 12V
	typ.	16.8W	9.6A, 12V

Fig. 9-1 **Efficiency vs. output current at 12V output voltage and 24V input voltage**

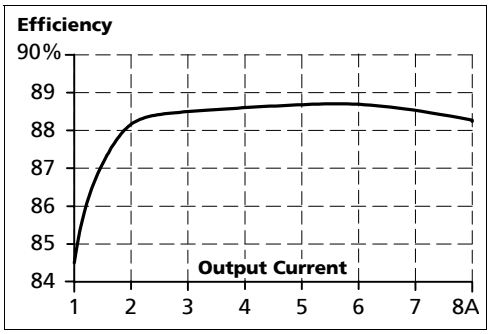


Fig. 9-2 **Losses vs. output current at 12V output voltage and 24V input voltage**

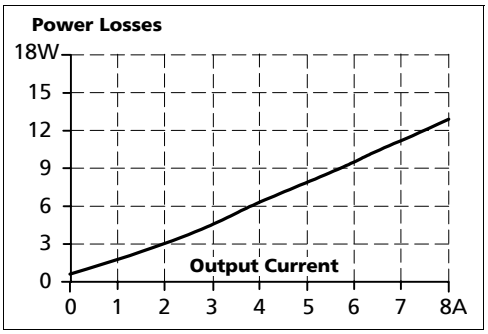


Fig. 9-3 **Efficiency vs. input voltage, 12V, 8A output**

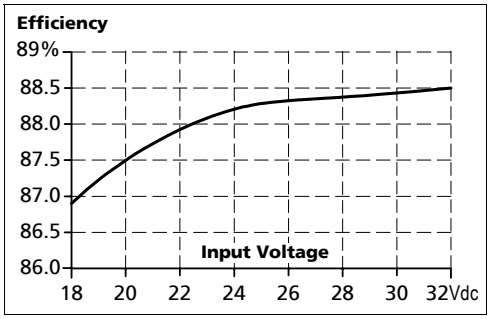


Fig. 9-4 **Losses vs. input voltage, 12V, 8A output**