5. INPUT VOLTAGE

Input	nom.	DC 48V	
Input voltage range	nom.	36.0-60.0Vdc	Continuous operation
	typ.	30.5-36.0Vdc	Max. 60 seconds or with de-rating, see Fig. 5-2
	max.	63.0Vdc	Absolute maximum continuous input voltage with no damage to the DC/DC converter. Please note that the unit can switch off above 60Vdc
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.	34.5Vdc	Steady-state value, see Fig. 5-1
Shut-down voltage	typ.	30.5Vdc	Steady-state value, see Fig. 5-1
	typ.	63.5Vdc	Steady-state value, see Fig. 5-1
Input current	typ.	2.75A	At 48Vdc input and output 24V, 5A, see Fig. 5-4
Start-up delay	typ.	670ms	0mF, 24V, 5A, constant current load, see Fig. 5-3
Rise time	typ.	80ms	0mF, 24V, 5A, constant current load, see Fig. 5-3
	typ.	150ms	5mF, 24V, 5A, constant current load, see Fig. 5-3
Turn-on overshoot	max.	500mV	See Fig. 5-3
Input capacitance	typ.	800µF	

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

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

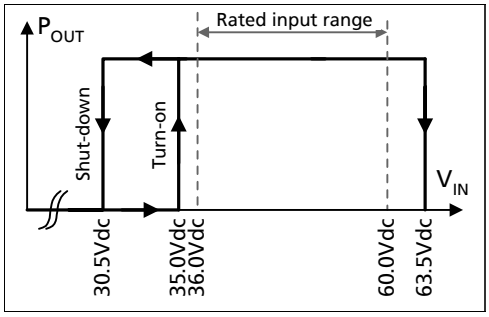


Fig. 5-2 **Allowable output current below 36V input voltage**

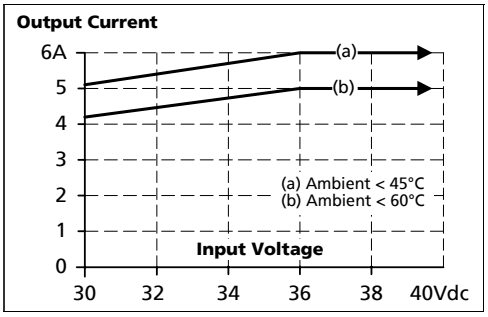


Fig. 5-3 **Turn-on behavior, definitions**

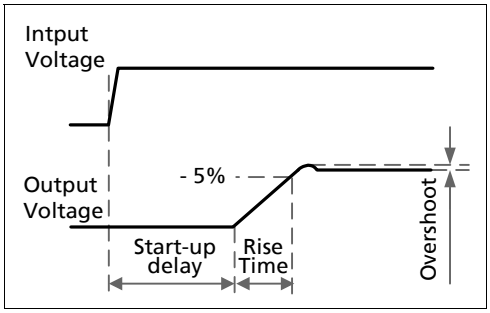
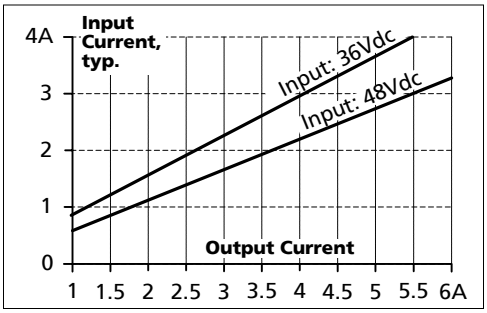


Fig. 5-4 **Input current vs. output load**



6. SOFT-START AND INPUT INRUSH CURRENT SURGE

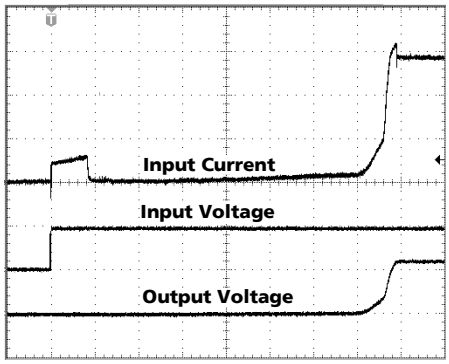
Inrush current limitation

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 48Vdc	
Inrush current	max.	$0.8A_{peak}$	-25°C to +70°C
	typ.	$0.6A_{peak}$	-25°C to +70°C
Inrush energy	typ.	negligible	-25°C to +70°C

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



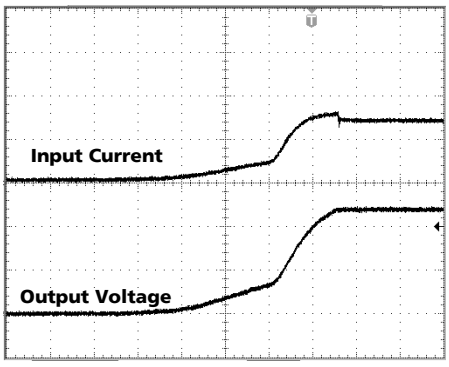
Input: 48Vdc
Output: 24Vdc, 5A, constant current load
Ambient: 25°C

Upper curve: Input current 1A / DIV
Middle curve: Input voltage 50V / DIV
Lower curve: Output voltage 20V / 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: 48Vdc
Output: 24Vdc, 5A, constant current load
Ambient: 25°C
No additional external capacitors

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

7. OUTPUT

Output voltage	nom.	24V	
Adjustment range	min.	23-28V	Guaranteed
	max.	30V	At clockwise end position of potentiometer
Factory setting		24.1V	±0.2%, at full load, cold unit
Line regulation	max.	25mV	Input variations between 36 to 60Vdc
Load regulation	max.	100mV	Static value, 0A → 5A → 0A
Ripple and noise voltage	max.	50mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	2200µF	
Output current	nom.	6A	At 24V, ambient < 45°C, see **Fig. 7-1**
	nom.	5A	At 24V, ambient < 60°C, see **Fig. 7-1**
	nom.	5.1A	At 28V, ambient < 45°C, see **Fig. 7-1**
	nom.	4.3A	At 28V, ambient < 60°C, see **Fig. 7-1**
Output power	nom.	144W	Ambient < 45°C
	nom.	120W	Ambient < 60°C
Short-circuit current	min.	7A	Load impedance 200mOhm, see **Fig. 7-1**
	max.	10A	Load impedance 200mOhm, see **Fig. 7-1**

Fig. 7-1 **Output voltage vs. output current, typ. (48Vdc input voltage)**

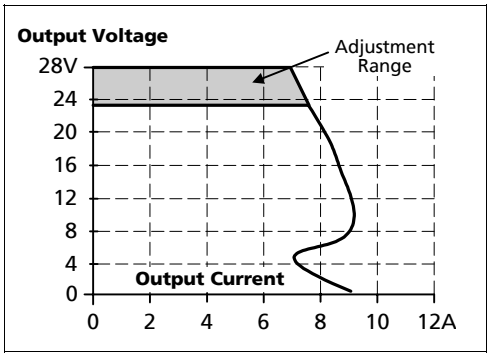
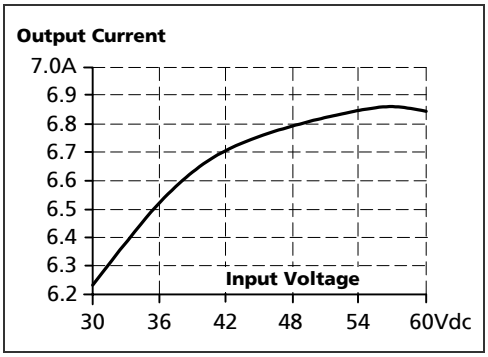


Fig. 7-2 **Current limitation vs. input voltage, typ. (23V constant voltage load)**



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 24V to 17.1V	At 10A for 50ms, resistive load
	typ.	from 24V to 15V	At 20A for 2ms, resistive load
	typ.	from 24V to 11V	At 20A 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 48Vdc	
Hold-up Time	typ.	10.5ms	Input 48Vdc, Output: 24Vdc, 2.5A, see **Fig. 8-1**
	typ.	5.6ms	Input 48Vdc, Output: 24Vdc, 5A, see **Fig. 8-1**

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

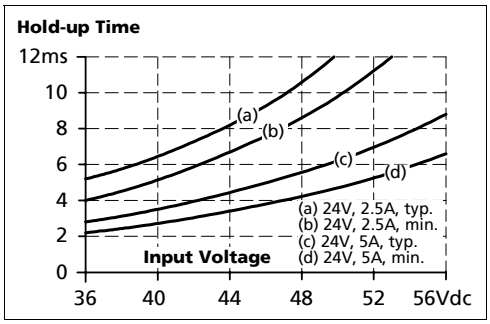


Fig. 8-2 **Shut-down test setup**

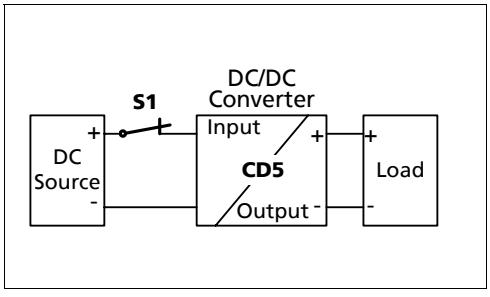
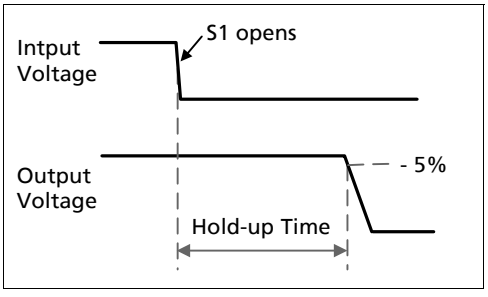


Fig. 8-3 **Shut-down behavior, definitions**



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 48Vdc	
Efficiency	typ.	90.3%	5A, 24V
Power losses	typ.	0.9W	At no output load
	typ.	6.9W	2.5A, 24V
	typ.	12.9W	5A, 24V
	typ.	16.4W	6A, 24V

Fig. 9-1 **Efficiency vs. output current at 24V output voltage and 48V input voltage**

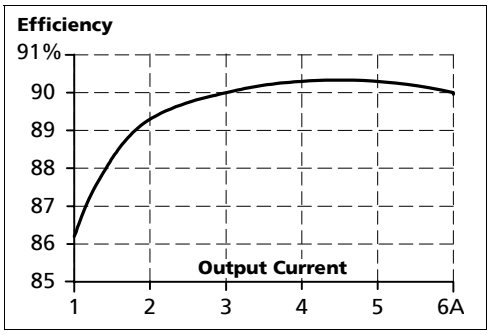


Fig. 9-2 **Losses vs. output current at 24V output voltage and 48V input voltage**

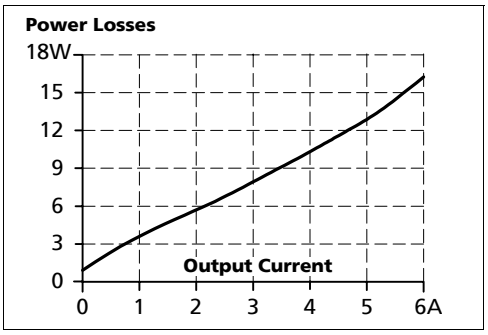


Fig. 9-3 **Efficiency vs. input voltage, 24V, 5A output**

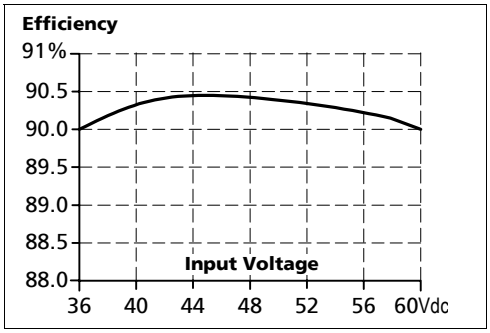


Fig. 9-4 **Losses vs. input voltage, 24V, 5A output**