

# PSR: Positive Switching Regulators

# PSC-Family

No input to output isolation  
 Single output of 5.1, 12, 15, 24 or 36 V DC/51...288 W  
 Input voltage up to 80 V DC

- High efficiency up to 96 %
- Wide input voltage range
- Low input-to-output differential voltage
- Very good dynamic properties
- Input undervoltage cut-out
- External output voltage adjustment and inhibit
- Continuous no-load and short-circuit proof
- No derating

Safety according to IEC 950



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## Type Survey

Table 1: Type survey

Nominal output voltage $U_{o \text{ nom}}$	Nominal output current $I_{o \text{ nom}}$	Input voltage range $U_i^1$	Nominal input voltage $U_{i \text{ nom}}$	Efficiency $\eta$	Type designation	Options	Superseded old type (phase-out)
5.1 V	12 A	7...40 V	20 V	83 %	PSC 5A12-7iR	-9, L, P, C, D	PSR 512-7
5.1 V	10 A	8...80 V	40 V	79 %	PSC 5A10-7iR		PSR 510-7
12 V	8 A	15...80 V		90 %	PSC 128-7iR		PSR 128-7
15 V		19...80 V	91 %	PSC 158-7iR	PSR 158-7		
24 V	29...80 V	50 V	94 %	PSC 248-7iR	PSR 248-7		
36 V	42...80 V	60 V	96 %	PSC 368-7iR	PSR 368-7		

<sup>1</sup>See data  $\Delta U_{i0 \text{ min}}$  (min. differential voltage  $U_i - U_o$ )

## Description

The PSC family of positive switching regulators is designed as power supply modules for electronic systems. Their major advantages include a high level of efficiency that remains virtually constant over the entire input range, high reliability, low ripple and excellent dynamic response. Modules with input up to 80 V are specially designed for secondary switched and battery driven applications. Case C03: Aluminium, black finish and self cooling.

### External input circuitry

An external capacitor (see "Application Notes") is required in rectifier mode and in DC operation mode only, if the sum of the lengths of the two input lines between source and input (without option L) is greater than approx. 5 m. For long connection lines the use of option L is recommended in order to reduce superimposed interference voltages or currents and to prevent oscillation.

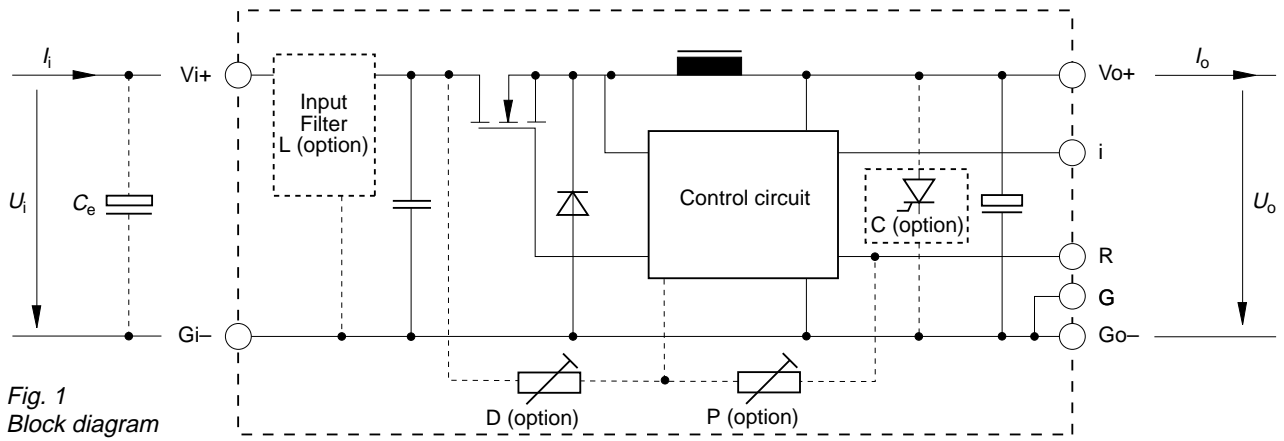


Fig. 1  
Block diagram

## Safety and Installation Instructions

### Safety

If the output circuit of a switching regulator is operator-accessible according to the IEC 950 related safety standards, it shall be an SELV circuit (Safety Extra Low Voltage circuit, i.e. a circuit, separated from mains by at least basic insulation, that is so designed and protected that under normal and single fault conditions, the voltage between any two conductors and between any conductor and earth does not exceed 60 V DC).

In the following section an interpretation is provided of the IEC 950 safety standard with respect to the safety status of the output circuit. However, it is the sole responsibility of the

installer or user to assure the compliance with the relevant and applicable safety standards.

If the following table is observed, the output of any switching regulator is considered to be an SELV circuit up to a nominal output voltage of 36 V.

**Note:** Check for hazardous voltages before altering any connections. Do not open the module. The input and the output circuitry are not separated, i.e. the negative path is internally interconnected!

Table 2: Insulation concept for SELV circuits

Nominal mains supply voltage (AC)	Minimum required grade of isolation, to be provided by the AC-DC front end, including mains supplied battery charger	Maximum output voltage from the front end	Minimum required safety status of the front end output circuit	Measures to achieve the specified safety status of the output circuit	Resulting safety status of the switching regulator output circuit
None	Battery supply completely separated from mains	≤60 V	SELV battery circuit	None	SELV circuit
		≤80 V	Hazardous voltage battery circuit <sup>2</sup>	Input fuse <sup>1</sup> and unearthed, non operator-accessible case <sup>2</sup>	SELV circuit
			Hazardous voltage battery circuit	Input fuse <sup>1</sup> and earthed output circuit <sup>3</sup> and earthed <sup>3</sup> or non operator-accessible case	Earthed SELV circuit
≤250 V	Basic	≤60 V	Earthed SELV circuit	Earthed input circuit <sup>3</sup>	SELV circuit
			ELV circuit	Input fuse <sup>1</sup> and earthed output circuit <sup>3</sup>	Earthed SELV circuit
		≤80 V	Hazardous voltage secondary circuit	Input fuse <sup>1</sup> and earthed output circuit <sup>3</sup> and earthed <sup>3</sup> or non operator-accessible case	Earthed SELV circuit
			Double or reinforced	≤60 V	SELV circuit
	≤80 V	Double or reinforced insulated unearthed hazardous voltage secondary circuit <sup>2</sup>	Input fuse <sup>1</sup> and unearthed and non operator-accessible case <sup>2</sup>	SELV circuit	

<sup>1</sup> The installer shall provide an approved fuse (slow blow type with lowest rating suitable for the application, max. 12.5 A) in the positive or negative input conductor directly at the input of the switching regulator. For UL's purpose, the fuse needs to be UL-listed. If option C is fitted, a suitable fuse is built-in.

<sup>2</sup> Has to be insulated from earth by double or reinforced insulation according to the relevant safety standard, based on the maximum input voltage of the switching regulator.

<sup>3</sup> The earth connection has to be provided by the installer according to the relevant safety standards, e.g. IEC 950.

**Standards and Approvals**

All Melcher power supplies are subject to manufacturing surveillance in accordance with ISO 9001 standards.  
 All units are UL recognized as per UL 1950, UL 1012 and CAN/CSA C22.2 No. 234-M90.

**Cleaning Agents**

In order to avoid possible damage, any penetration of cleaning fluids is to be prevented, since the power supplies are not hermetically sealed.

**Protection Degree**

The protection degree is defined by IP 20.

**Standard Features**

**i Inhibit**

**Note:** With open i-input, output is enabled ( $U_o = \text{on}$ )

The inhibit input allows the switching regulators to be disabled via a control signal. In systems with several units, this feature can be used, for example, to control the activation sequence of the regulators by a logic signal (TTL, C-MOS, etc.).

An output voltage overshoot will not occur when the units are switched on or off.

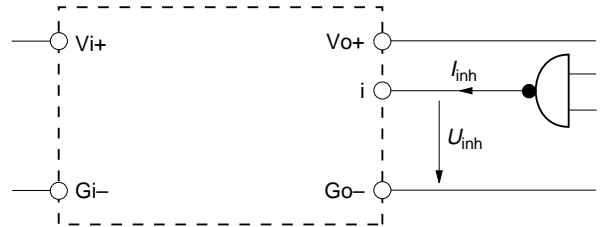


Fig. 2  
 Definition of  $I_{inh}$  and  $U_{inh}$

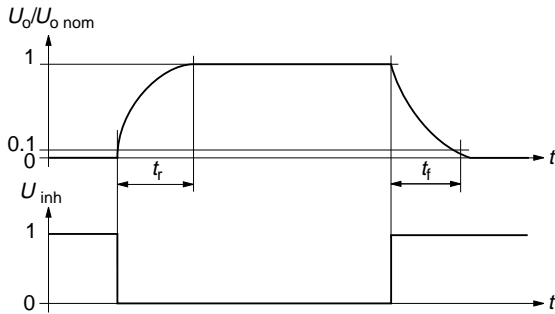


Fig. 3  
 Output response as a function of inhibit signal

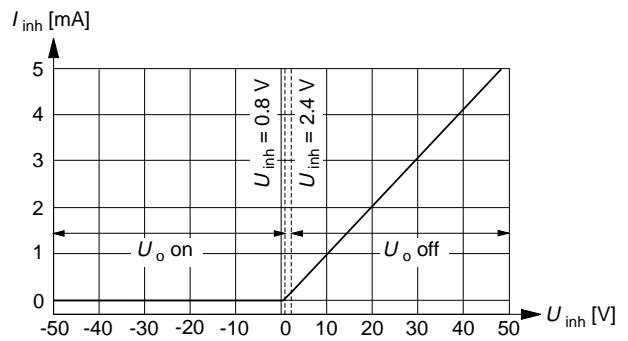


Fig. 4  
 Inhibit current  $I_{inh}$  versus inhibit voltage  $U_{inh}$

**Data**

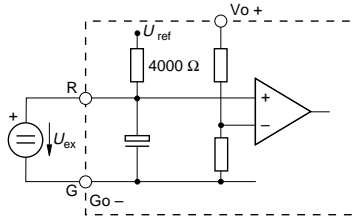
Table 3: Inhibit characteristics

Characteristics		Conditions	min	typ	max	Unit
$U_{inh}$	Inhibit input voltage to keep regulator output voltage...	$U_o = \text{on}$	$U_{i \text{ min}} \dots U_{i \text{ max}}$	-50	+0.8	V DC
		$U_o = \text{off}$	$T_C \text{ min} \dots T_C \text{ max}$	+2.4	+50	
$t_r$	Switch-on time after inhibit command	$U_i = U_{i \text{ nom}}$		5		ms
$t_f$	Switch-off time after inhibit command	$R_L = U_{o \text{ nom}} / I_{o \text{ nom}}$		10		
$I_{i \text{ off}}$	Input current when inhibited	$I_o = 0, U_i = U_{i \text{ nom}}$		10		mA

**R External Output Voltage Adjustment**

**Note:** With open R input,  $U_o = U_{o\ nom}$ .  
 (For superseded PSR types,  $U_o = 1.08 \cdot U_{o\ nom}$ )

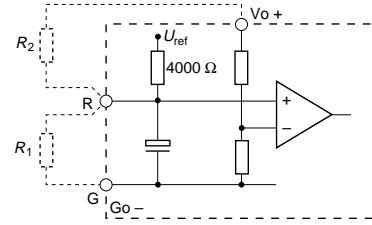
R-input and option P cannot be supported simultaneously. The output voltage  $U_o$  can either be adjusted with an external resistor ( $R_1$  or  $R_2$ ) or with an external voltage ( $U_{ex}$ ). The adjustment range is 0...1.08 of  $U_{o\ nom}$ . The minimal differential voltage  $\Delta U_{io\ min}$  between input and output should be maintained (see data). Min. input = Undervoltage lock-out.



**Fig. 5**  
Voltage adjustment with  $U_{ex}$  [V] between R and G (Go-):

a)  $U_o \approx U_{ex} \cdot \frac{U_{o\ nom}}{U_{ref}}$  ( $U_{ref} = 2.5\ V \pm 2\%$ )

**Caution:** To prevent damage  $U_{ex}$  should not exceed 20 V, nor be negative.



**Fig. 6**  
Voltage adjustment with external resistor  $R_1$  or  $R_2$  [ $\Omega$ ]

b)  $U_o = 0 \dots 100\% U_{o\ nom}$ , using  $R_1$  between R and G (Go-):

$$U_o \approx U_{o\ nom} \cdot \frac{R_1}{R_1 + 4000} \quad R_1 \approx \frac{4000 \cdot U_o}{U_{o\ nom} - U_o}$$

c)  $U_o = U_{o\ nom} \dots U_{o\ max}$ , using  $R_2$  between R and Vo+:

$$U_{o\ max} = U_{o\ nom} + 8\%$$

$$U_o \approx U_{ref} \cdot \frac{R_2}{k \cdot (R_2 + 4000) - 4000} \quad k = \frac{U_{ref}}{U_{o\ nom}}$$

$$R_2 \approx 4000 \cdot \frac{U_o \cdot (1-k)}{k \cdot U_o - U_{ref}} \quad (U_{ref} = 2.5\ V \pm 2\%)$$

All formulae give approximate values only.

**Immunity to Environmental Conditions**

Table 4: Mechanical stress

Test Method	Standard	Test Conditions	Status
Ca Damp heat steady state	DIN 40046 part IEC 68-2-3 MIL-STD-810D section 507.2	Temperature: 40 ± 2 °C Relative humidity: 93 +2/-3 % Duration: 56 days	Unit not operating
Ea Shock (half-sinusoidal)	DIN 40046 part 7 IEC 68-2-27 MIL-STD-810D section 516.3	Acceleration amplitude: 100 g <sub>n</sub> = 981 m/s <sup>2</sup> Bump duration: 6 ms Number of bumps: 18 (3 each direction)	Unit operating
Eb Continuous shock (half-sinusoidal)	DIN 40046 part 26 IEC 68-2-29 MIL-STD-810D section 516.3	Acceleration amplitude: 40 g <sub>n</sub> = 392 m/s <sup>2</sup> Bump duration: 6 ms Number of bumps: 6000 (1000 each direction)	Unit operating
Fc Vibration (sinusoidal)	DIN 40046 part 8 IEC 68-2-6 MIL-STD-810D section 514.3	Frequency (1 Oct/min): 10...2000 Hz Max. vibration amplitude: 0.35 mm (10...60 Hz) Acceleration amplitude: 5 g <sub>n</sub> = 49 m/s <sup>2</sup> (60...2000 Hz) Test duration: 7.5 h (2.5 h each axis)	Unit operating
Fda Random vibration wide band reproducibility high	DIN 40046 part 23 IEC 68-2-35	Acceleration spectral density: 0.05 g <sup>2</sup> /Hz Frequency band: 20...500 Hz Acceleration magnitude: 4.9 g <sub>rms</sub> Test duration: 3 h (1 h each axis)	Unit not operating
Kb Salt mist cyclic (sodium chloride NaCl solution)	DIN 40046 part 105 IEC 68-2-52	Concentration: 5% (30 °C) Duration: 2 h per cycle Storage: 40 °C, 93% rel. humidity Storage duration: 22 h per cycle Number of cycles: 3	Unit not operating

Table 5: Temperature specifications, valid for air pressure of 800...1200 hPa (800...1200 mbar)

Temperature		Standard -7		Option -9		Unit
Characteristics	Conditions	min	max	min	max	
$T_A$ Ambient temperature <sup>1</sup>	$U_{i\ min} \dots U_{i\ max}$	-25	71	-40	71	°C
$T_C$ Case temperature	$I_o = 0 \dots I_{o\ nom}$	-25	95	-40	95	
$T_S$ Storage temperature <sup>1</sup>	Not operational	-40	100	-55	100	

<sup>1</sup> MIL-STD-810D section 501.2 and 502.2

Table 6: MTBF and device hours

MTBF	Ground Benign	Ground Fixed		Ground Mobile	Device Hours <sup>1</sup>
MTBF acc. to MIL-HDBK-217F	$T_C = 40^\circ\text{C}$	$T_C = 40^\circ\text{C}$	$T_C = 70^\circ\text{C}$	$T_C = 50^\circ\text{C}$	2'800'000 h
	660'000 h	143'000 h	81'000 h	68'000 h	

<sup>1</sup> Statistical values, based on an average of 4300 working hours per year and in general field use

## Electromagnetic Compatibility EMC

### Immunity

General condition: Case not earthed.

Table 7: Immunity type tests

Phenomenon	Standard	Class Level	Coupling mode <sup>4</sup>	Value applied	Waveform	Source Imped.	Test procedure	In oper.	Per-form.
Impulse voltage	IEC 255-4 App. E4 <sup>5</sup> (1976)	III	i/o, i/c, o/c +i/-i	5000 V <sub>p</sub>	1.2/50 μs	500 Ω	3 pos. and 3 neg. impulses per coupling mode	no	-
High frequency disturbance	IEC 255-4 App. E5 <sup>5</sup> (1976)	III	i/o, i/c, o/c	2500 V <sub>p</sub>	400 damped 1 MHz waves/s	200 Ω	2 s per coupling mode	yes	<sup>1</sup>
			+i/-i	1000 V <sub>p</sub>					
Voltage surge	IEC 571-1 (1990-07)		i/c, +i/-i	800 V <sub>p</sub>	100 μs	100 Ω	1 pos. and 1 neg. voltage surge per coupling mode	yes	<sup>2</sup>
				1500 V <sub>p</sub>	50 μs				
				3000 V <sub>p</sub>	5 μs				
				4000 V <sub>p</sub>	1 μs				
				7000 V <sub>p</sub>	100 ns				
Electrostatic discharge	IEC 801-2 (1991-04)	3	contact discharge to case	6000 V <sub>p</sub>	1/50 ns	330 Ω	10 positive and 10 negative discharges	yes	<sup>1 6</sup>
Electric field	IEC 801-3 (1984)	2	antenna in 1m distance	3 V/m	sine wave modulated w. 1 kHz		26...1000 MHz	yes	<sup>1</sup>
Fast transient/burst	IEC 801-4 (1988)	3	i/c, +i/-i	2000 V <sub>p</sub>	bursts of 5/50 ns 5 kHz rep. rate transients with 15 ms burst duration and a 300 ms period	50 Ω	1 min positive 1 min negative bursts per coupling mode	yes	<sup>1 3 6</sup>
Transient	IEC 801-5 (Draft 1993-01)	III	i/c	2000 V <sub>p</sub>	1.2/50 μs	12 Ω	5 pos. and 5 neg. impulses per coupling mode	yes	<sup>2, 6</sup>
			+i/-i	1000 V <sub>p</sub>		2 Ω			
Immunity to conducted disturbances	IEC 801-6	3	i, o, signal wires	10 V <sub>rms</sub> <sup>7</sup>	80% amplitude modulated with 1 kHz	50 Ω	AM 0.15...80 MHz	yes	<sup>1</sup>

<sup>1</sup> Normal operation, no deviation from specifications

<sup>2</sup> Normal operation, temporary deviation from specs possible

<sup>3</sup> With option C: manual reset

<sup>4</sup> i = input, o = output, c = case

<sup>5</sup> In correspondance with DIN 57435 part 303 and VDE 0435 part 303 (1984-09)

<sup>6</sup> Option L necessary

<sup>7</sup> Open circuit

### Emission

For emission levels refer to "Electrical Input and Output Data".

## Electrical Input and Output Data

### General Conditions

- $T_A = 25^\circ\text{C}$ , unless  $T_C$  is specified.
- With R or option P, output voltage  $U_o = U_{o\text{ nom}}$  at  $I_{o\text{ nom}}$

Table 8a: Input and output data

Characteristics		Conditions	PSC 5A12			PSC 5A10			PSC 128			Unit
			min	typ	max	min	typ	max	min	typ	max	
<b>Output</b>												
$U_{o\text{ nom}}$	Output voltage	$U_{i\text{ nom}}, I_{o\text{ nom}}$	5.07	5.13	5.07	5.13	11.92	12.07			V	
$I_{o\text{ nom}}$	Output current	$U_{i\text{ min}} \dots U_{i\text{ max}}$	12.0			10.0			8.0			A
$I_{oL}$	Output current limitation response	$T_C\text{ min} \dots T_C\text{ max}$	12.0	15.6	10.0	13.0	8.0	10.4				
$u_o$	Ripple at output (BW = 20 MHz)	$U_{i\text{ nom}}$ $I_{o\text{ nom}}$	35	50	35	50	80	150			mV <sub>pp</sub>	
$\Delta U_{oU}$	Static control deviation versus input voltage $U_i$	$U_{i\text{ min}} \dots U_{i\text{ max}}$ $I_{o\text{ nom}}$	30	45	30	45	50	75			mV	
$\Delta U_{oI}$	Static control deviation versus output current $I_o$	$U_{i\text{ nom}}$ $I_o = 0 \dots I_{o\text{ nom}}$	20	25	20	25	30	35				
$u_{od}$	Dynamic control deviation <sup>1</sup>	$U_{i\text{ nom}}$ $I_{o\text{ nom}} \leftrightarrow 1/3 I_{o\text{ nom}}$	130		130		130					
$t_r$	Dynamic load transient time recovery <sup>1</sup>		40		50		60				$\mu\text{s}$	
$\alpha_{uo}$	Temperature coefficient $\Delta U_o / \Delta T_C$	$U_{i\text{ min}} \dots U_{i\text{ max}}$ $T_C\text{ min} \dots T_C\text{ max}$ $I_o = 0 \dots I_{o\text{ nom}}$	$\pm 1$			$\pm 1$			$\pm 2$			mV/K
			$\pm 0.02$			$\pm 0.02$			$\pm 0.02$			%/K
<b>Input</b>												
$U_i$	Input voltage	$I_o = 0 \dots I_{o\text{ nom}}$ $T_C\text{ min} \dots T_C\text{ max}$	7	40	8	80	15	80			V DC	
$\Delta U_{io\text{ min}}$	Minimum differential voltage $U_i - U_o$ <sup>2</sup>		2			3			3			V
$U_{io}$	Undervoltage cut-out		6.3			7.3			7.3			
$I_o$	No load input current	$I_o = 0$ $U_{i\text{ min}} \dots U_{i\text{ max}}$	45			40			35			
$I_m$	Peak value of inrush current <sup>3</sup>	$U_{i\text{ nom}}$	150			250			250			A
$t_s$	Rise time <sup>3</sup>		5			5			5			$\mu\text{s}$
$t_r$	Tail half value time <sup>3</sup>		40			40			40			
$I_m$	Peak value of inrush current <sup>3</sup>	$U_{i\text{ nom}}$ with option L	250			350			350			A
$t_s$	Rise time <sup>3</sup>		25			25			25			$\mu\text{s}$
$t_r$	Tail half value time <sup>3</sup>		125			125			125			
$U_{i\text{ rfi}}$	RFI level at input, <sup>4</sup> 0.01...30 MHz	VDE 0871 (6.78) $U_{i\text{ min}} \dots \text{max}, I_{o\text{ nom}}$	B			B			B			dB ( $\mu\text{V}$ )
<b>Efficiency</b>												
$\eta$	Efficiency	$U_{i\text{ nom}}, I_{o\text{ nom}}$	83			79			90			%
<b>Isolation</b>												
$U_{is}$	Isolation test voltage electronics to case	Inputs/outputs interconnected	750			750			750			V DC

<sup>1</sup> See "Dynamic characteristics"

<sup>2</sup> The minimum differential voltage  $\Delta U_{io\text{ min}}$  between input and output increases linearly from 0 to 1 V at  $T_A = 46^\circ\text{C}$  and  $71^\circ\text{C}$  ( $T_C = 70^\circ\text{C}$  and  $95^\circ\text{C}$ )

<sup>3</sup> Definitions according to VDE 0433, part 3

<sup>4</sup> With option L and additional external input capacitor  $C_e = 120 \mu\text{F}/100 \text{ V}$ , e.g. Nichicon, PF(M) series, or equivalent

Table 8b: Input and output data

Characteristics		Conditions	PSC 158			PSC 248			PSC 368			Unit
			min	typ	max	min	typ	max	min	typ	max	
<b>Output</b>												
$U_{o\ nom}$	Output voltage	$U_{i\ nom}, I_{o\ nom}$	14.91	15.09	23.85	24.14	35.78	36.22				V
$I_{o\ nom}$	Output current	$U_{i\ min}...U_{i\ max}$	8.0			8.0			8.0			A
$I_{oL}$	Output current limitation response	$T_C\ min...T_C\ max$	8.0	10.4	8.0	10.4	8.0	10.4				
$u_o$	Ripple at output (BW = 20 MHz)	$U_{i\ nom}$ $I_{o\ nom}$	80	150	100	250	150	300				mV <sub>pp</sub>
$\Delta U_{oU}$	Static control deviation versus input voltage $U_i$	$U_{i\ min}...U_{i\ max}$ $I_{o\ nom}$	70	100	150	220	200	270				mV
$\Delta U_{oI}$	Static control deviation versus output current $I_o$	$U_{i\ nom}$ $I_o = 0...I_{o\ nom}$	35	45	120	160	125	160				
$u_{o\ d}$	Dynamic control deviation <sup>1</sup>	$U_{i\ nom}$ $I_{o\ nom} \leftrightarrow 1/3 I_{o\ nom}$	130			150			220			
$t_r$	Dynamic load transient time recovery <sup>1</sup>		60			80			100			μs
$\alpha_{uo}$	Temperature coefficient $\Delta U_o/\Delta T_C$	$U_{i\ min}...U_{i\ max}$ $T_C\ min...T_C\ max$ $I_o = 0...I_{o\ nom}$	±3			±5			±8			mV/K
			±0.02			±0.02			±0.02			%/K
<b>Input</b>												
$U_i$	Input voltage	$I_o = 0...I_{o\ nom}$ $T_C\ min...T_C\ max$	19	80	29	80	42	80				V DC
$\Delta U_{io\ min}$	Minimum differential voltage $U_i - U_o$ <sup>2</sup>		4				5	6			V	
$U_{io}$	Undervoltage cut-out		7.3				12	19				
$I_{io}$	No load input current	$I_o = 0$ $U_{i\ min}...U_{i\ max}$	35			35			40			mA
$I_{im}$	Peak value of inrush current <sup>3</sup>	$U_{i\ nom}$	250			250			250			A
$t_{is}$	Rise time <sup>3</sup>		5			5			5			μs
$t_{ir}$	Tail half value time <sup>3</sup>		40			40			40			
$I_{im}$	Peak value of inrush current <sup>3</sup>	$U_{i\ nom}$ with option L	350			350			350			A
$t_{is}$	Rise time <sup>3</sup>		25			25			25			μs
$t_{ir}$	Tail half value time <sup>3</sup>		125			125			125			
$U_{i\ rfi}$	RFI level at input, <sup>4</sup> 0.01...30 MHz	VDE 0871 (6.78) $U_{i\ min}...max, I_{o\ nom}$	B			B			B			dB (μV)
<b>Efficiency</b>												
$\eta$	Efficiency	$U_{i\ nom}, I_{o\ nom}$	91			94			96			%
<b>Isolation</b>												
$U_{is}$	Isolation test voltage electronics to case	Inputs/outputs interconnected	750			750			750			V DC

<sup>1</sup> See "Dynamic characteristics"<sup>2</sup> The minimum differential voltage  $\Delta U_{io\ min}$  between input and output increases linearly from 0 to 1 V at  $T_A = 46^\circ\text{C}$  and  $71^\circ\text{C}$  ( $T_C = 70^\circ\text{C}$  and  $95^\circ\text{C}$ )<sup>3</sup> Definitions according to VDE 0433, part 3<sup>4</sup> With option L and additional external input capacitor  $C_o = 120\ \mu\text{F}/100\ \text{V}$ , e.g. Nichicon, PF(M) series, or equivalent

## Characteristics and Definitions

### Output Protection

A voltage suppressor diode protects the output against an internally generated overvoltage, which could occur due to a failure of the control circuit, which in worst case conditions fails into a short circuit. The suppressor diode is not designed to withstand externally applied overvoltages. The user should ensure that systems with Melcher power supplies, in the event of a failure, do not result in an unsafe condition (fail-safe).

### Dynamic Characteristics

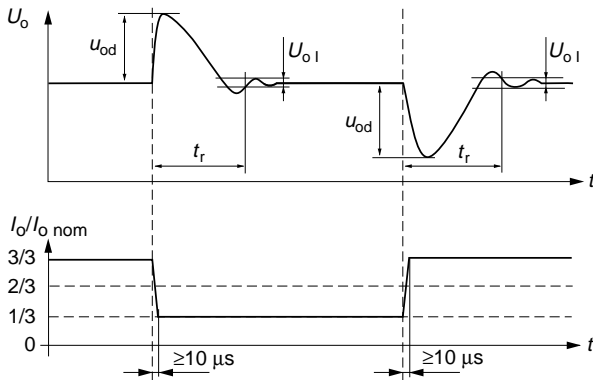


Fig. 7 Behaviour and characteristics under varying load conditions.

### Temperature

When a converter is located in free, quasi-stationary air at a temperature  $T_A = 71^\circ\text{C}$  and is operated at its nominal output power, the case temperature  $T_C$  will be about  $95^\circ\text{C}$  after the warm-up phase measured at the measuring point of case temperature  $T_C$  (see "Mechanical Data").

Under practical operating conditions, the ambient temperature  $T_A$  may exceed  $71^\circ\text{C}$ , provided additional measures are taken to ensure that the case temperature  $T_C$  does not exceed its maximum value of  $95^\circ\text{C}$  (heat sink, fan, etc.).

Example: Sufficient forced cooling allows  $T_{A,max} = 85^\circ\text{C}$ . A simple check of the case temperature  $T_C$  ( $T_C \leq 95^\circ\text{C}$ ) at full load ensures correct operation of the system

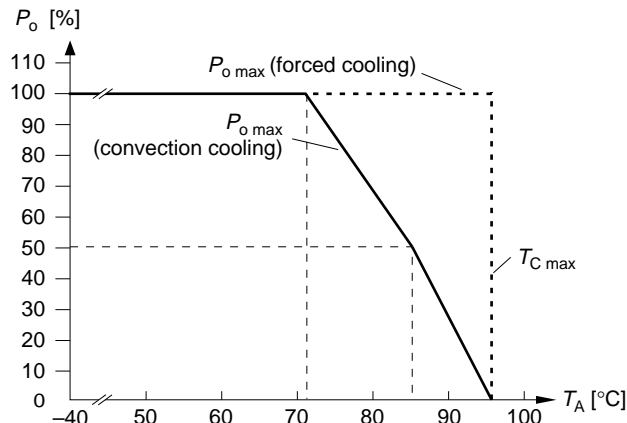


Fig. 8 Output power derating versus ambient temperature

### Parallel and Series Connection

Outputs of equal nominal voltages can be parallel-connected. However, the use of a single unit with higher output power, because of its power dissipation, is always a better solution.

In parallel-connected operation, one or several outputs may operate continuously at their current limit knee-point which will cause an increase of the case temperature. Consequently, the max. ambient temperature value should be reduced by 10 K.

Outputs can be series-connected with any other module. In series-connection the maximum output current is limited by the lowest current limitation. Galvanically separated source voltages are needed for each module!

### Short circuit behaviour

A constant current limitation circuit holds the output current almost constant whenever an overload or a short circuit is applied to the regulator's output. It acts self-protecting and recovers - in contrary to the fold back method - automatically after removal of the overload or short circuit condition.

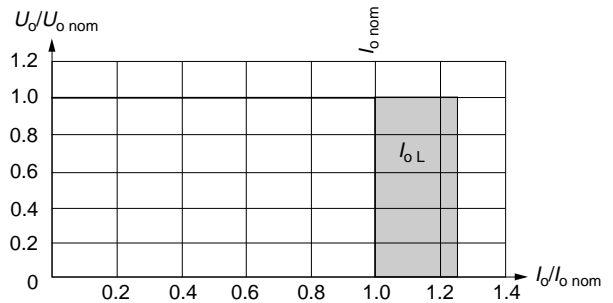


Fig. 9 Overload, short-circuit behaviour  $U_o$  versus  $I_o$



## Description of Options

### Option -9 Extended Temperature Range

The operational ambient temperature range is extended to  $T_A = -40...71^\circ\text{C}$ .

### Option L Input filter

Option L is recommended to reduce superimposed interference voltages, and to prevent oscillations, if input lines exceed approx. 5 m in total length. The fundamental wave (approx. 120 kHz) of the reduced interference voltage between  $V_{i+}$  and  $G_{i-}$  has, with an input line inductance of  $5\ \mu\text{H}$  a maximum magnitude of  $4\ \text{mV}_{\text{rms}}$ .

The input impedance of the switching regulator at 120 kHz is about  $50\ \text{m}\Omega$ . The harmonics are small in comparison with the fundamental wave. See also data: RFI.

With option L, the maximum permissible additionally superimposed ripple  $u_i$  of the input voltage (rectifier mode) at a specified input frequency  $f_i$  has the following values:

Input voltage up to 80 V:

$$u_{i\ \text{max}} = 22\ V_{\text{pp}} \text{ at } 100\ \text{Hz} \text{ or } V_{\text{pp}} = 2200\ \text{Hz}/f_i \cdot 1\ \text{V}$$

Input voltage up to 40 V:

$$u_{i\ \text{max}} = 12\ V_{\text{pp}} \text{ at } 100\ \text{Hz} \text{ or } V_{\text{pp}} = 1200\ \text{Hz}/f_i \cdot 1\ \text{V}$$

### Option P Potentiometer

Option P and the R-function cannot be supported simultaneously. The output voltage  $U_o$  can be adjusted with a screwdriver in the range from 0.92...1.08 of the nominal output voltage  $U_{o\ \text{nom}}$ .

However, the minimum differential voltage  $\Delta U_{i\ o\ \text{min}}$  between input and output voltages as specified in "Electrical Input and Output Data" should be maintained.

### Option C Thyristor Crowbar

This option is recommended to protect the load against power supply malfunction, but it is not designed to sink external currents.

A fixed-value monitoring circuit checks the output voltage  $U_o$ . When the trigger voltage  $U_{o\ c}$  is reached, the thyristor crowbar triggers and disables the output. It may be deactivated by removal of the input voltage. In case of a switching transistor defect, an internal fuse prevents excess current.

**Note:** As a central overvoltage protection device, the crowbar is usually connected to the external load via distributed inductance of the lines. For this reason, the overvoltage at the load can temporarily exceed the trigger voltage  $U_{o\ c}$ . Depending on the application, further decentralized overvoltage protection elements may have to be used additionally.

Table 9: Crowbar trigger levels

Characteristics		Conditions	5.1		12 V		15 V		24 V		36 V		Unit
			min	max	min	max	min	max	min	max	min	max	
$U_{o\ c}$	Trigger voltage	$U_{i\ \text{min}}...U_{i\ \text{max}}$ $I_o = 0...I_{o\ \text{nom}}$	5.8	6.8	13.5	16	16.5	19	27	31	40	45.5	V
$t_s$	Delay time	$T_{C\ \text{min}}...T_{C\ \text{max}}$	1.5		1.5		1.5		1.5		1.5		$\mu\text{s}$

### Option U Ambient Temp. Range acc. UL Recognition

Underwriters Laboratories (UL) have approved the PSC family as recognized components up to an ambient temperature of  $T_{A\ \text{max}} - 25\ \text{K}$  given by the upper temperature limit of the standard PCB material. If the full maximum ambient temperature  $T_{A\ \text{max}}$  is required with UL approval, option U should be requested. It consists of an alternative

PCB material with a higher maximum temperature specification.

The European approval boards have in contrast to UL accepted the standard PCB material to be operated up to  $T_{A\ \text{max}} = 71^\circ\text{C}$  without any further precautions.

**Option D** ("Save Data", input undervoltage monitor)

**Note:** Output instead of input undervoltage monitor is available on request (Option D1).

If the input voltage  $U_i$  is below the adjustable threshold voltage  $U_t$ , the control circuit for terminal D has low impedance. Terminal D and Go- are connected to a self-conducting field effect transistor (FET). A 0.5 W Zener diode provides protection against overvoltages.

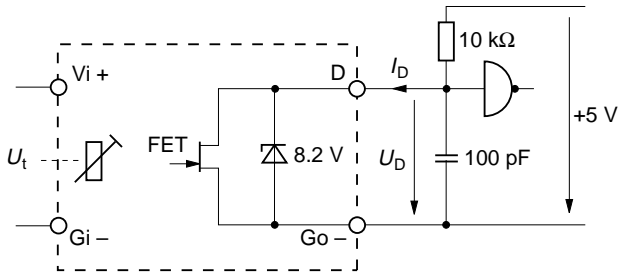


Fig. 10  
Test circuit with definition of voltage  $U_D$  and current  $I_D$  on Terminal D.

The voltage  $U_t$  can be externally adjusted with a trim potentiometer by means of a screwdriver. The hysteresis  $U_H$  of  $U_t$  is <2%. Terminal D stays low for a minimum time  $t_{low\ min}$ , in order to prevent any oscillation.  $U_t$  can be set to a value between  $U_{i\ min}$  and  $U_{i\ max}$ . It is important to note that the FET can become conductive again when  $U_D > U_t - 3V$ .

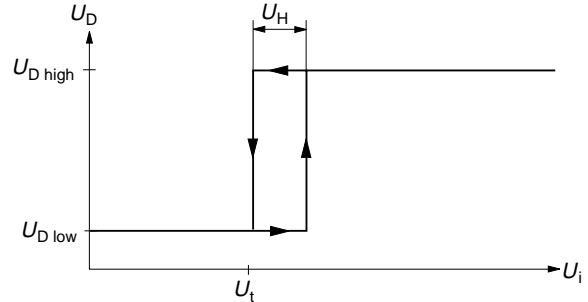


Fig. 11  
Definition of  $U_t$  and  $U_H$

**Data**

Table 10: Option D data

Characteristics		Conditions	PSC			Unit
			min	typ	max	
$U_{D\ low}$	Voltage - Terminal D at low impedance	$U_i < U_t, I_D \leq 2.5\ mA$			0.8	V
$U_{D\ high}$	Voltage - Terminal D at high impedance	$U_i > U_t + U_H, I_D > 25\ \mu A$	4.75			
$t_{low\ min}$	Minimum duration $U_{D\ low}$		30			ms
$t_{D\ f}$	Response time to $U_{D\ low}$		1			$\mu s$
$I_{D\ max}$	Maximum current - Terminal D				20	mA

## Application examples

- The signal  $U_D$  can be utilized in battery powered systems to provide a warning in case of **low batteries**.
- In case of power failure, the signal can serve to initiate **data save** routines.

**Mechanical Data**

Dimensions in mm. Tolerances  $\pm 0.3$  mm unless otherwise specified.

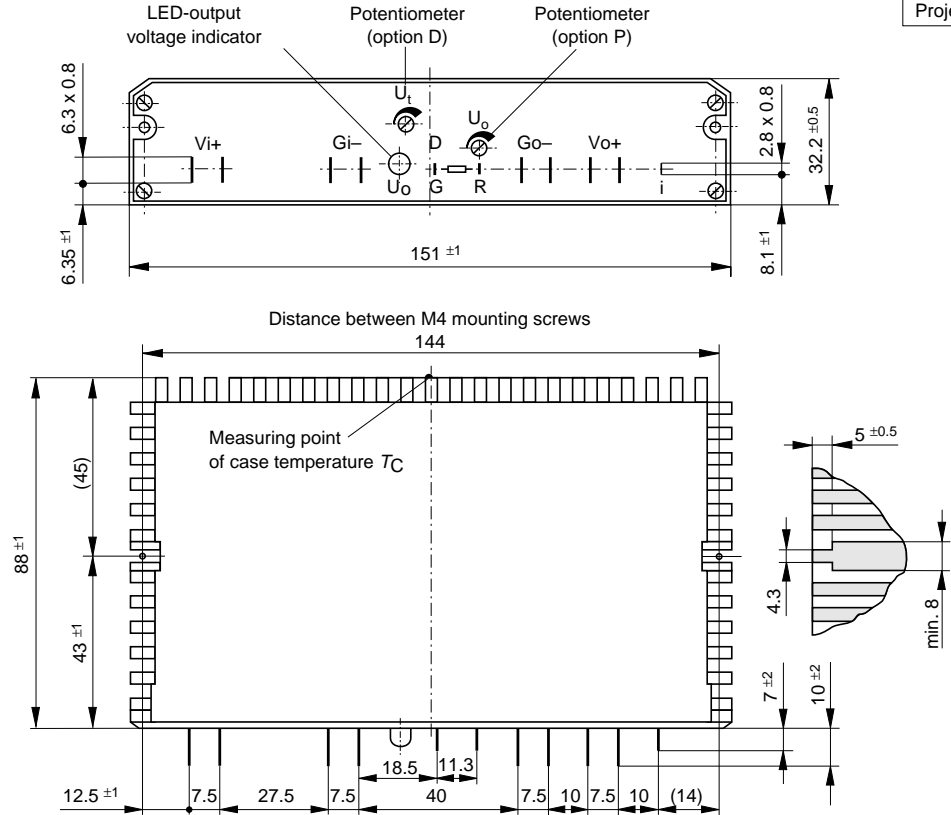
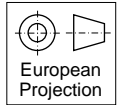


Fig. 12  
Case C03 (weight 440 g)

**Type Key and Product Marking**

**Type Key**

Positive switching regulator in case C03 .....	PSC	_____	PSC
Blank .....		_____	
Nominal output voltage in volt (5A → 5.1) .....	5.1...36	_____	12 8 - 7 Li R P C D
Nominal output current in ampere .....	8...12	_____	
Ambient temperature range			
$T_A = -25...71^\circ\text{C}$ .....	-7	_____	
$T_A = -40...71^\circ\text{C}$ .....	-9	_____	
Input filter .....	L	_____	
Inhibit input .....	i	_____	
External output voltage adjustment .....	R	_____	
Potentiometer .....	P	_____	
Thyristor-Crowbar .....	C	_____	
"Save Data" undervoltage monitor .....	D	_____	

Example: PSC 128-7LiPC = A positive switching regulator with a 12 V, 8 A output, ambient temperature range of  $-25...71^\circ\text{C}$ , input filter, inhibit input, potentiometer and thyristor-crowbar.

**Produkt Marking**

Main face: Family designation, applicable safety approval and recognition marks, warnings, Melcher patent nos. and company logo.

Cover: Specific type designation, input voltage range, nominal output voltage and current, pin allocation, identification of LED, potentiometers and degree of protection.

Rear side: Label with batch no., serial no. and data code comprising production site, modification status of the main PCB and date of production.