



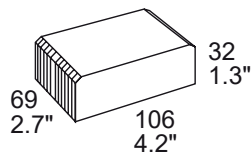
**MELCHER™**  
The Power Partners.

## PSB Series Positive Switching Regulator

The PSB Series of positive switching regulators are designed as power supplies for electronic systems, where no input-to-output isolation is required. Their major advantages include a high level of efficiency, high reliability, low output ripple, and excellent dynamic response. Models with input voltages up to 144V are specially designed for secondary switched and battery-driven mobile applications. The converters are suitable for railway applications according to EN 50155 and EN 50121.

The case design allows for operation up to 71 °C. The PSB Series is designed for wall or chassis mounting with faston connectors.

Various options are available to adapt the converters to different applications.



### Features

- RoHS lead-free-solder and lead-solder-exempted products are available
- 5 year warranty for RoHS compliant products with an extended temperature range
- Input voltage up to 144 VDC
- Single output of 5.1 to 48 VDC
- No input-to-output isolation
- High efficiency up to 96%
- Extremely wide input voltage range
- Low input-to-output differential voltage
- Very good dynamic properties
- Input undervoltage lockout
- Output voltage adjustment and inhibit function
- Continuously no-load and short-circuit proof
- All boards are coated with a protective lacquer

Safety-approved to the latest edition of IEC/EN 62368-1 and UL/CSA 60950-1



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### Model Selection

Table 1: Model Selection

| Output voltage<br>$V_{o\ nom}$ [V] | Output current<br>$I_{o\ nom}$ [A] | Operating input voltage range<br>$V_i$ [V] | Nom. input voltage<br>$V_{i\ nom}$ [V] | Efficiency <sup>2</sup> |                  | Type designation | Options            |
|------------------------------------|------------------------------------|--------------------------------------------|----------------------------------------|-------------------------|------------------|------------------|--------------------|
|                                    |                                    |                                            |                                        | $\eta_{min}$ [%]        | $\eta_{max}$ [%] |                  |                    |
| 5.1                                | 4 <sup>3</sup>                     | 15 - 144 <sup>1</sup>                      | 60                                     | 76                      | 80               | PSB5A4-9iRG      | L, C               |
| 5.1                                | 6                                  | 8 - 80                                     | 40                                     | 79                      | 82.5             | PSB5A6-9iRG      | -7, L, C, non-G    |
| 5.1                                | 7                                  | 7 - 40                                     | 20                                     | 83                      | 84.5             | PSB5A7-9iRG      | -7, L, P, C, non-G |
| 5.1                                | 8                                  | 7 - 40                                     | 20                                     | 82.5                    | 84               | PSB5A8-2iRG      | non-G              |
| 12                                 | 3 <sup>4</sup>                     | 18 - 144 <sup>1</sup>                      | 60                                     | 87                      | 88.5             | PSB123-9iRG      | -7, L, C, non-G    |
| 12                                 | 5                                  | 15 - 80                                    | 40                                     | 89                      | 90.5             | PSB125-9iRG      | -7, L, C, non-G    |
| 12                                 | 6                                  | 15 - 40                                    | 20                                     | 89.5                    | 91               | PSB126-2iRG      | ---                |
| 15                                 | 3 <sup>4</sup>                     | 22 - 144 <sup>1</sup>                      | 60                                     | 89                      | 90               | PSB153-9iRG      | -7, L, C, non-G    |
| 15                                 | 5                                  | 19 - 80                                    | 40                                     | 90.5                    | 92.5             | PSB155-9iRG      | -7, L, C, non-G    |
| 15                                 | 6                                  | 19 - 40                                    | 30                                     | 91                      | 92.5             | PSB156-2iRG      | ---                |
| 24                                 | 3 <sup>4</sup>                     | 31 - 144 <sup>1</sup>                      | 60                                     | 92.5                    | 94               | PSB243-9iRG      | -7, L, C, non-G    |
| 24                                 | 5                                  | 29 - 80                                    | 50                                     | 93.5                    | 95               | PSB245-9iRG      | -7, L, C, non-G    |
| 24                                 | 6                                  | 29 - 60                                    | 40                                     | 94                      | 96               | PSB246-2iRG      | non-G              |
| 36                                 | 3 <sup>4</sup>                     | 44 - 144 <sup>1</sup>                      | 80                                     | 94                      | 95               | PSB363-9iRG      | -7, L, C, non-G    |
| 36                                 | 5                                  | 42 - 80                                    | 60                                     | 95.5                    | 96.5             | PSB365-9iRG      | -7, L, C, non-G    |
| 48                                 | 3 <sup>4</sup>                     | 58 - 144 <sup>1</sup>                      | 80                                     | 95.5                    | 96.5             | PSB483-9iRG      | -7, L, C, non-G    |

<sup>1</sup> Surges up to 156 V for 2 s; see *Electrical Input Data*

<sup>2</sup> Efficiency at  $V_{i\ nom}$  and  $I_{o\ nom}$

<sup>3</sup>  $I_{o\ max} = 5\ A$  at  $V_i \leq 80\ V$ ; for  $V_i > 80\ V$ , see fig. 4.

<sup>4</sup>  $I_{o\ max} = 4\ A$  at  $V_i \leq 80\ V$ ; for  $V_i > 80\ V$ , see fig. 4.

NFND: Not for new designs.

Preferred for new designs.

**Note:** The sequence of options must follow the order above.

### Part Number Description

PSB 12 3 -9 L i R C G

Positive switching regulator in case B02 ..... PSB

Nominal output voltage in volt ..... 5.1 to 48

Nominal output current in Ampère ..... 3 to 8

Operational ambient temperature range  $T_A$

-10 to 50 °C ..... -2

-25 to 50 °C ..... -5

-25 to 71 °C (option) ..... -7

-40 to 71 °C ..... -9

other (customer-specific models) ..... 0

Input filter (option) ..... L

Inhibit input (standard) ..... i

Control input for output voltage adjustment<sup>1</sup> ..... R

Potentiometer<sup>1</sup> (option) ..... P

Thyristor crowbar (option) ..... C

RoHS-compliant for all 6 substances ..... G

<sup>1</sup> Feature R excludes option P and vice versa.

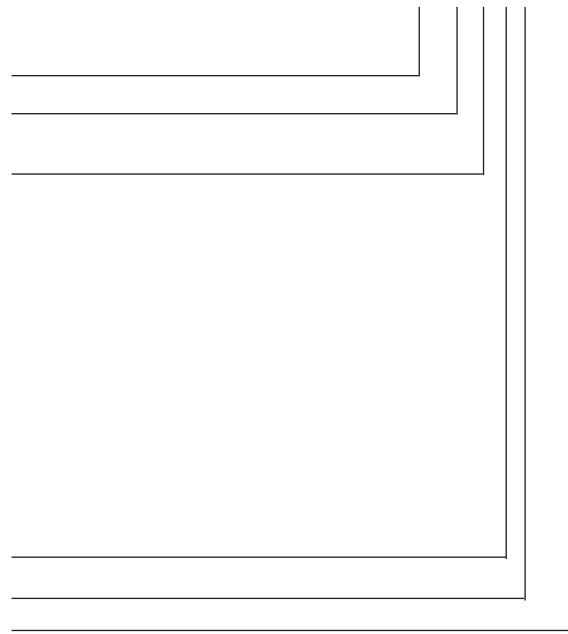
**Note:** The sequence of options must follow the order above.

Example: PSB123-9LiRCG designates a positive switching regulator with output 12 V, 3 A, ambient temperature range of -40 to 71 °C, input filter, inhibit input, output adjust input, thyristor crowbar, and RoHS-compliant.

### Customer-Specific Models

Positive switching regulator in case B01 ..... PSB  
 Nominal output voltage in Volt (without decimals) ..... 12  
 Decimal places:  
   0.0 V ..... Z  
   0.1 V ..... A  
   0.15 V ..... B  
   0.2 V ..... C  
   0.25 V ..... D  
   0.3 V ..... E  
   0.4 V ..... F  
   0.5 V ..... G  
   0.6 V ..... H  
   0.7 V ..... J  
   0.8 V ..... K  
   0.9 V ..... L  
   other ..... Y  
 Output current in Amperes ..... 3  
 Identification character ..... A, B, ...  
 Temperature range and options ..... -9iRG

PSB 12 Z 3 A -9iRG



### Product Marking

Type designation, applicable safety approval marks, warnings, pin allocation, patent nos., and company logo.

Input voltage range, nominal output voltage and current, pin allocation of auxiliary functions and options, and protection degree. Identification of LED and the optional potentiometer.

Label with input voltage range, nominal output voltage and current, protection degree, batch no., serial no., and data code including production site, version (modification status), date of production.

### Functional Description

This switching regulator uses the buck converter topology. The input is not electrically isolated from the output. During the on period of the switching transistor, current is transferred to the output, and energy is stored in the output choke. During the off period, this energy forces the current to keep flowing through the output, to the load, and back through the freewheeling diode. Regulation is accomplished by varying the duty cycle (on/ratio) of the power switch. The regulator is equipped with a undervoltage lockout, but no overvoltage shutdown.

These regulators are ideal for a wide range of applications, where input to output isolation is not necessary, or where already provided by an external front end (e.g., a transformer with rectifier). To optimize customer's needs, additional options and accessories are available.

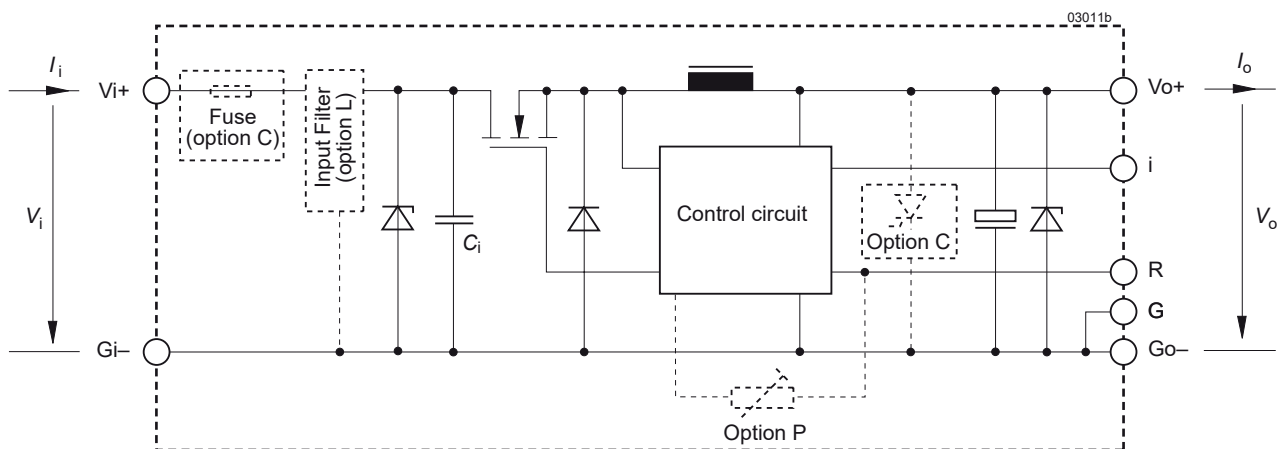


Fig. 1  
Block diagram PSB

## Electrical Input Data

General Conditions:  $T_A = 25\text{ °C}$ , unless  $T_C$  is specified

Table 2a: Input data (-2 models)

| Model                      |                                | PSB5A8                                                                |     |     | PSB126 |      |     | PSB156 |      |     | PSB246 |      |     | Unit |       |    |
|----------------------------|--------------------------------|-----------------------------------------------------------------------|-----|-----|--------|------|-----|--------|------|-----|--------|------|-----|------|-------|----|
| Characteristics            |                                | Conditions                                                            | min | typ | max    | min  | typ | max    | min  | typ | max    | min  | typ |      | max   |    |
| $V_i$                      | Operating input voltage        | $I_o = 0 - I_{o\text{ nom}}$<br>$T_{C\text{ min}} - T_{C\text{ max}}$ | 7   |     | 40     | 15   |     | 40     | 19   |     | 40     | 29   |     | 60   | V     |    |
| $\Delta V_{io\text{ min}}$ | Min. diff. voltage $V_i - V_o$ |                                                                       |     |     | 1.9    |      |     | 3      |      |     |        | 4    |     |      |       | 5  |
| $V_{i\text{ UVL}}$         | Undervoltage lockout           |                                                                       |     |     | 7.3    |      |     | 7.3    |      |     |        | 7.3  |     |      |       | 12 |
| $I_{i0}$                   | No-load input current          | $I_o = 0, V_{i\text{ min}} - V_{i\text{ max}}$                        |     |     | 50     |      |     | 50     |      |     | 50     |      |     | 50   | mA    |    |
| $I_{inr\text{ p}}$         | Inrush peak current            | $V_{i\text{ nom}}$                                                    |     |     | 75     |      |     | 75     |      |     | 150    |      |     | 150  | A     |    |
| $R_i$                      | Input resistance               | no option L                                                           |     |     | 10     |      |     | 10     |      |     | 10     |      |     | 10   | mΩ    |    |
| $C_i$                      | Input capacitance              |                                                                       |     |     |        | 13.6 |     |        | 13.6 |     |        | 13.6 |     |      | 13.6  | μF |
| $V_{i\text{ RFI}}$         | EN 55011, 0.15 - 30 MHz        | $V_{i\text{ nom}}, I_{o\text{ nom}}$                                  |     |     | A      |      |     | A      |      |     | A      |      |     | A    | Class |    |

Table 2b: Input data

| Model                      |                                | PSB5A7                                                                |   |     | PSB5A6 |     |     | PSB125 |     |     | Unit |       |
|----------------------------|--------------------------------|-----------------------------------------------------------------------|---|-----|--------|-----|-----|--------|-----|-----|------|-------|
| Characteristics            |                                | Conditions                                                            |   | min | typ    | max | min | typ    | max | min |      | typ   |
| $V_i$                      | Operating input voltage        | $I_o = 0 - I_{o\text{ nom}}$<br>$T_{C\text{ min}} - T_{C\text{ max}}$ | 7 |     | 40     | 8   |     | 80     | 15  |     | 80   | V     |
| $\Delta V_{io\text{ min}}$ | Min. diff. voltage $V_i - V_o$ |                                                                       |   |     | 1.9    |     |     | 2.9    |     |     | 3    |       |
| $V_{i\text{ UVL}}$         | Undervoltage lockout           |                                                                       |   | 6.3 |        |     | 7.3 |        |     | 7.3 |      |       |
| $I_{i0}$                   | No-load input current          | $I_o = 0, V_{i\text{ min}} - V_{i\text{ max}}$                        |   |     | 45     |     |     | 40     |     |     | 35   | mA    |
| $I_{inr\text{ p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>without option L                                |   |     | 75     |     |     | 150    |     |     | 150  | A     |
| $R_i$                      | Input resistance               |                                                                       |   |     | 10     |     |     | 10     |     |     | 10   | mΩ    |
| $C_i$                      | Input capacitance              |                                                                       |   |     | 13.6   |     |     | 13.6   |     |     | 13.6 | μF    |
| $I_{inr\text{ p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>with option L                                   |   |     | 100    |     |     | 180    |     |     | 180  | A     |
| $R_i$                      | Input resistance               |                                                                       |   |     | 340    |     |     | 340    |     |     | 340  | mΩ    |
| $C_i$                      | Input capacitance              |                                                                       |   |     | 484    |     |     | 344    |     |     | 344  | μF    |
| $V_{i\text{ RFI}}$         | EN 55011, 0.15 - 30 MHz        | $V_{i\text{ nom}}, I_{o\text{ nom}}$<br>with option L                 |   |     | A      |     |     | A      |     |     | A    | Class |

Table 2c: Input data

| Model                      |                                                    |                                                                       | PSB155 |     |      | PSB245 |     |      | PSB365 |     |      | Unit  |
|----------------------------|----------------------------------------------------|-----------------------------------------------------------------------|--------|-----|------|--------|-----|------|--------|-----|------|-------|
| Characteristics            |                                                    | Conditions                                                            | min    | typ | max  | min    | typ | max  | min    | typ | max  |       |
| V <sub>i</sub>             | Operating input voltage                            | $I_o = 0 - I_{o\text{ nom}}$<br>$T_{C\text{ min}} - T_{C\text{ max}}$ | 19     |     | 80   | 29     |     | 80   | 42     |     | 80   | V     |
| $\Delta V_{io\text{ min}}$ | Min. diff. voltage V <sub>i</sub> – V <sub>o</sub> |                                                                       |        |     | 4    |        |     | 5    |        |     | 6    |       |
| V <sub>i UVL</sub>         | Undervoltage lockout                               |                                                                       |        |     | 7.3  |        |     | 12   |        |     | 19   |       |
| I <sub>i0</sub>            | No-load input current                              | $I_o = 0, V_{i\text{ min}} - V_{i\text{ max}}$                        |        |     | 35   |        |     | 35   |        |     | 40   | mA    |
| I <sub>inr p</sub>         | Inrush peak current                                | V <sub>i nom</sub><br>without option L                                |        |     | 150  |        |     | 150  |        |     | 150  | A     |
| R <sub>i</sub>             | Input resistance                                   |                                                                       |        |     | 10   |        |     | 10   |        |     | 10   | mΩ    |
| C <sub>i</sub>             | Input capacitance                                  |                                                                       |        |     | 13.6 |        |     | 13.6 |        |     | 13.6 | μF    |
| I <sub>inr p</sub>         | Inrush peak current                                | V <sub>i nom</sub><br>with option L                                   |        |     | 180  |        |     | 180  |        |     | 180  | A     |
| R <sub>i</sub>             | Input resistance                                   |                                                                       |        |     | 340  |        |     | 340  |        |     | 340  | mΩ    |
| C <sub>i</sub>             | Input capacitance                                  |                                                                       |        |     | 344  |        |     | 344  |        |     | 344  | μF    |
| V <sub>i RFI</sub>         | EN 55011, 0.15 - 30 MHz                            | V <sub>i nom</sub> , I <sub>o nom</sub><br>with option L              |        |     | A    |        |     | A    |        |     | A    | Class |

Table 2d: Input data. General Conditions as per Table 2a

| Model                       |                                |                                                                       | PSB5A4 |                |                  | PSB123 |                |                  | PSB153 |                |                  | Unit  |
|-----------------------------|--------------------------------|-----------------------------------------------------------------------|--------|----------------|------------------|--------|----------------|------------------|--------|----------------|------------------|-------|
| Characteristics             |                                | Conditions                                                            | min    | typ            | max              | min    | typ            | max              | min    | typ            | max              |       |
| $V_i$                       | Operating input voltage        | $I_o = 0 - I_{o\text{ nom}}$<br>$T_{C\text{ min}} - T_{C\text{ max}}$ | 15     |                | 144 <sup>1</sup> | 18     |                | 144 <sup>1</sup> | 22     |                | 144 <sup>1</sup> | V     |
| $\Delta V_{i\text{ o min}}$ | Min. diff. voltage $V_i - V_o$ |                                                                       |        |                | 9.9              |        |                | 6                |        |                | 7                |       |
| $V_{i\text{ UVL}}$          | Undervoltage lockout           |                                                                       |        | 10             |                  |        | 12             |                  |        | 15             |                  |       |
| $I_{i0}$                    | No-load input current          | $I_o = 0, V_{i\text{ min}} - V_{i\text{ max}}$                        |        |                | 40               |        |                | 35               |        |                | 35               | mA    |
| $I_{i\text{ nr p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>without option L                                |        | 150            |                  |        | 150            |                  |        | 150            |                  | A     |
| $R_i$                       | Input resistance               |                                                                       |        | 10             |                  |        | 10             |                  |        | 10             |                  | mΩ    |
| $C_i$                       | Input capacitance              |                                                                       |        | 4.4            |                  |        | 4.4            |                  |        | 4.4            |                  | μF    |
| $I_{i\text{ nr p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>with option L                                   |        | 180            |                  |        | 180            |                  |        | 180            |                  | A     |
| $R_i$                       | Input resistance               |                                                                       |        | 340            |                  |        | 340            |                  |        | 340            |                  | mΩ    |
| $C_i$                       | Input capacitance              |                                                                       |        | 104            |                  |        | 104            |                  |        | 104            |                  | μF    |
| $V_{i\text{ RFI}}$          | EN 55011, 0.15 - 30 MHz        | $V_{i\text{ nom}}, I_{o\text{ nom}}$<br>with option L <sup>2</sup>    |        | A <sup>2</sup> |                  |        | A <sup>2</sup> |                  |        | A <sup>2</sup> |                  | Class |

Table 2e: Input data

| Model                       |                                |                                                                       | PSB243 |                |                  | PSB363 |                |                  | PSB483 |                |                  | Unit  |
|-----------------------------|--------------------------------|-----------------------------------------------------------------------|--------|----------------|------------------|--------|----------------|------------------|--------|----------------|------------------|-------|
| Characteristics             |                                | Conditions                                                            | min    | typ            | max              | min    | typ            | max              | min    | typ            | max              |       |
| $V_i$                       | Operating input voltage        | $I_o = 0 - I_{o\text{ nom}}$<br>$T_{C\text{ min}} - T_{C\text{ max}}$ | 31     |                | 144 <sup>1</sup> | 44     |                | 144 <sup>1</sup> | 58     |                | 144 <sup>1</sup> | V     |
| $\Delta V_{i\text{ o min}}$ | Min. diff. voltage $V_i - V_o$ |                                                                       |        |                | 7                |        |                | 8                |        |                | 10               |       |
| $V_{i\text{ UVL}}$          | Undervoltage lockout           |                                                                       |        | 19             |                  |        | 29             |                  |        | 40             |                  |       |
| $I_{i0}$                    | No-load input current          | $I_o = 0, V_{i\text{ min}} - V_{i\text{ max}}$                        |        |                | 35               |        |                | 40               |        |                | 45               | mA    |
| $I_{i\text{ nr p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>without option L                                |        | 150            |                  |        | 150            |                  |        | 150            |                  | A     |
| $R_i$                       | Input resistance               |                                                                       |        | 10             |                  |        | 10             |                  |        | 10             |                  | mΩ    |
| $C_i$                       | Input capacitance              |                                                                       |        | 4.4            |                  |        | 4.4            |                  |        | 4.4            |                  | μF    |
| $I_{i\text{ nr p}}$         | Inrush peak current            | $V_{i\text{ nom}}$<br>with option L                                   |        | 180            |                  |        | 180            |                  |        | 180            |                  | A     |
| $R_i$                       | Input resistance               |                                                                       |        | 340            |                  |        | 340            |                  |        | 340            |                  | mΩ    |
| $C_i$                       | Input capacitance              |                                                                       |        | 104            |                  |        | 104            |                  |        | 104            |                  | μF    |
| $V_{i\text{ RFI}}$          | EN 55011, 0.15 - 30 MHz        | $V_{i\text{ nom}}, I_{o\text{ nom}}$<br>with option L <sup>2</sup>    |        | A <sup>2</sup> |                  |        | A <sup>2</sup> |                  |        | A <sup>2</sup> |                  | Class |

<sup>1</sup> Surges up to 156 V for 2 s

<sup>2</sup> With external input capacitor  $C_i = 470\text{ μF} / 200\text{ V}$  and option L

### External Input Circuitry and Fuse

The sum of the lengths of the supply lines to the source or to the nearest capacitor  $\geq 100\text{ μF}$  (a + b) should not exceed 5 m, unless option L is fitted. This option is recommended in order to prevent power line oscillations and reduce superimposed interference voltages.

Regulators with option C are fitted with an input fuse.

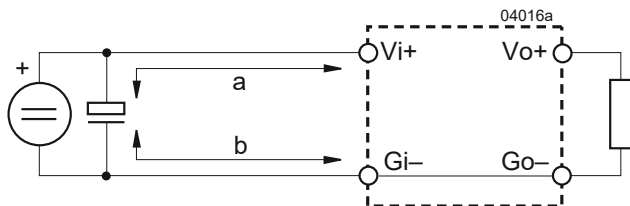


Fig. 2  
Switching regulator with long supply lines.

## Electrical Output Data

General conditions:

- $T_A = 25^\circ\text{C}$ , unless  $T_C$  is specified
- R-input open (or  $V_o$  set to  $V_{o\text{nom}}$  with option P)

Table 3a: Output data

| Output          |                                                                                          |                                                                                             | PSB5A8 |     |            | PSB126 |     |            | PSB156 |     |            | PSB246 |     |            | Unit             |
|-----------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------|-----|------------|--------|-----|------------|--------|-----|------------|--------|-----|------------|------------------|
| Characteristics |                                                                                          | Conditions                                                                                  | min    | typ | max        | min    | typ | max        | min    | typ | max        | min    | typ | max        |                  |
| $V_o$           | Output voltage                                                                           | $V_{i\text{nom}}, I_{o\text{nom}}$                                                          | 5.05   |     | 5.15       | 11.6   |     | 12.4       | 14.5   |     | 15.5       | 23.3   |     | 24.7       | V                |
| $I_o$           | Output current                                                                           | $V_{i\text{min}} - V_{i\text{max}}$                                                         | 0      |     | 8.0        | 0      |     | 6.0        | 0      |     | 6.0        | 0      |     | 6.0        | A                |
| $I_{oL}$        | Output current limitation                                                                | $T_{C\text{min}} - T_{C\text{max}}$                                                         | 8.0    |     | 10.4       | 6.0    |     | 7.8        | 6.0    |     | 7.8        | 6.0    |     | 7.8        |                  |
| $V_o$           | Output voltage noise                                                                     | Switching frequency<br>$V_{i\text{nom}}, I_{o\text{nom}}$<br>IEC/EN 61204                   |        |     | 40         |        |     | 150        |        |     | 200        |        |     | 300        | mV <sub>pp</sub> |
|                 |                                                                                          | Total<br>BW = 20 MHz                                                                        |        |     | 45         |        |     | 160        |        |     | 210        |        |     | 310        |                  |
| $\Delta V_{oV}$ | Static line regulation                                                                   | $V_{i\text{min}} - V_{i\text{max}}, I_{o\text{nom}}$                                        |        |     | 100        |        |     | 240        |        |     | 300        |        |     | 480        | mV               |
| $\Delta V_{oI}$ | Static load regulation                                                                   | $V_{i\text{nom}}, I_o = 0 - I_{o\text{nom}}$                                                |        |     | 100        |        |     | 180        |        |     | 200        |        |     | 300        |                  |
| $V_{oD}$        | Dynamic load regulation                                                                  | Voltage deviation<br>$V_{i\text{nom}}, I_{o\text{nom}} \leftrightarrow 1/3 I_{o\text{nom}}$ |        | 150 |            |        | 360 |            |        | 450 |            |        | 700 |            | $\mu\text{s}$    |
| $t_d$           | Recovery time                                                                            | IEC/EN 61204                                                                                |        | 100 |            |        | 120 |            |        | 120 |            |        | 160 |            |                  |
| $\alpha_{V_o}$  | Temperature coefficient<br>$\Delta V_o / \Delta T_C (T_{C\text{min}} - T_{C\text{max}})$ | $V_{i\text{min}} - V_{i\text{max}}, I_o = 0 - I_{o\text{nom}}$                              |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ | %/K              |

Table 3b: Output data

| Output          |                                                                                          |                                                                                             | PSB5A7 |     |            | PSB5A6 |     |            | PSB125 |     |            | Unit             |
|-----------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------|-----|------------|--------|-----|------------|--------|-----|------------|------------------|
| Characteristics |                                                                                          | Conditions                                                                                  | min    | typ | max        | min    | typ | max        | min    | typ | max        |                  |
| $V_o$           | Output voltage                                                                           | $V_{i\text{nom}}, I_{o\text{nom}}$                                                          | 5.07   |     | 5.13       | 5.07   |     | 5.13       | 11.93  |     | 12.07      | V                |
| $I_o$           | Output current                                                                           | $V_{i\text{min}} - V_{i\text{max}}$                                                         | 0      |     | 7.0        | 0      |     | 6.0        | 0      |     | 5.0        | A                |
| $I_{oL}$        | Output current limitation                                                                | $T_{C\text{min}} - T_{C\text{max}}$                                                         | 7.0    |     | 9.1        | 6.0    |     | 7.8        | 5.0    |     | 6.5        |                  |
| $V_o$           | Output voltage noise                                                                     | Switching frequency<br>$V_{i\text{nom}}, I_{o\text{nom}}$<br>IEC/EN 61204                   |        | 15  | 25         |        | 15  | 35         |        | 25  | 45         | mV <sub>pp</sub> |
|                 |                                                                                          | Total<br>BW = 20 MHz                                                                        |        | 19  | 29         |        | 19  | 39         |        | 29  | 49         |                  |
| $\Delta V_{oV}$ | Static line regulation                                                                   | $V_{i\text{min}} - V_{i\text{max}}, I_{o\text{nom}}$                                        |        |     | 100        |        |     | 100        |        |     | 240        | mV               |
| $\Delta V_{oI}$ | Static load regulation                                                                   | $V_{i\text{nom}}, I_o = 0 - I_{o\text{nom}}$                                                |        |     | 100        |        |     | 100        |        |     | 120        |                  |
| $V_{oD}$        | Dynamic load regulation                                                                  | Voltage deviation<br>$V_{i\text{nom}}, I_{o\text{nom}} \leftrightarrow 1/3 I_{o\text{nom}}$ |        | 150 |            |        | 130 |            |        | 360 |            | $\mu\text{s}$    |
| $t_d$           | Recovery time                                                                            | IEC/EN 61204                                                                                |        | 50  |            |        | 50  |            |        | 60  |            |                  |
| $\alpha_{V_o}$  | Temperature coefficient<br>$\Delta V_o / \Delta T_C (T_{C\text{min}} - T_{C\text{max}})$ | $V_{i\text{min}} - V_{i\text{max}}, I_o = 0 - I_{o\text{nom}}$                              |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ | %/K              |

Table 3c: Output data. General conditions as per table 3a

| Output          |                                                                                            |                                                                                                    | PSB155 |     |            | PSB245 |     |            | PSB365 |     |            | Unit             |
|-----------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------|-----|------------|--------|-----|------------|--------|-----|------------|------------------|
| Characteristics |                                                                                            | Conditions                                                                                         | min    | typ | max        | min    | typ | max        | min    | typ | max        |                  |
| $V_o$           | Output voltage                                                                             | $V_{i\text{ nom}}, I_{o\text{ nom}}$                                                               | 14.91  |     | 15.09      | 23.68  |     | 24.14      | 35.78  |     | 36.22      | V                |
| $I_o$           | Output current                                                                             | $V_{i\text{ min}} - V_{i\text{ max}}$                                                              | 0      |     | 5.0        | 0      |     | 5.0        | 0      |     | 5.0        | A                |
| $I_{oL}$        | Output current limitation                                                                  | $T_{C\text{ min}} - T_{C\text{ max}}$                                                              | 5.0    |     | 6.5        | 5.0    |     | 6.5        | 5.0    |     | 6.5        |                  |
| $V_o$           | Output voltage noise                                                                       | Switching frequency<br>$V_{i\text{ nom}}, I_{o\text{ nom}}$<br>IEC/EN 61204                        |        | 40  | 70         |        | 45  | 120        |        | 70  | 180        | mV <sub>pp</sub> |
|                 |                                                                                            | Total<br>BW = 20 MHz                                                                               |        | 44  | 74         |        | 50  | 125        |        | 75  | 185        |                  |
| $\Delta V_{oV}$ | Static line regulation                                                                     | $V_{i\text{ min}} - V_{i\text{ max}}, I_{o\text{ nom}}$                                            |        | 40  | 75         |        | 70  | 150        |        | 100 | 200        | mV               |
| $\Delta V_{oI}$ | Static load regulation                                                                     | $V_{i\text{ nom}}, I_o = 0 - I_{o\text{ nom}}$                                                     |        | 30  | 65         |        | 70  | 120        |        | 120 | 160        |                  |
| $V_{oD}$        | Dynamic load regulation                                                                    | Voltage deviation<br>$V_{i\text{ nom}}$<br>$I_{o\text{ nom}} \leftrightarrow 1/3 I_{o\text{ nom}}$ |        | 100 |            |        | 120 |            |        | 180 |            | $\mu\text{s}$    |
| $t_d$           | Recovery time                                                                              | IEC/EN 61204                                                                                       |        | 60  |            |        | 80  |            |        | 100 |            |                  |
| $\alpha_{Vo}$   | Temperature coefficient<br>$\Delta V_o / \Delta T_C (T_{C\text{ min}} - T_{C\text{ max}})$ | $V_{i\text{ min}} - V_{i\text{ max}}$<br>$I_o = 0 - I_{o\text{ nom}}$                              |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ | %/K              |

Table 3d: Output data

| Output             |                                                                                            |                                                                                                    | PSB5A4 |     |            | PSB123 |     |            | PSB153 |     |            | Unit             |
|--------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------|-----|------------|--------|-----|------------|--------|-----|------------|------------------|
| Characteristics    |                                                                                            | Conditions                                                                                         | min    | typ | max        | min    | typ | max        | min    | typ | max        |                  |
| $V_o$              | Output voltage                                                                             | $V_{i\text{ nom}}, I_{o\text{ nom}}$                                                               | 5.07   |     | 5.13       | 11.93  |     | 12.07      | 14.91  |     | 15.09      | V                |
| $I_{o\text{ nom}}$ | Output current nominal                                                                     | $V_{i\text{ min}} - V_{i\text{ max}}$                                                              |        | 4.0 |            |        | 3.0 |            |        | 3.0 |            | A                |
| $I_{o\text{ max}}$ | Output current max                                                                         | $V_{i\text{ min}} - 80\text{ V}$                                                                   |        | 5.0 |            |        | 4.0 |            |        | 4.0 |            |                  |
| $I_{oL}$           | Output current limitation                                                                  | $T_{C\text{ min}} - T_{C\text{ max}}$                                                              | 5.0    |     | 6.5        | 4.0    |     | 5.2        | 4.0    |     | 5.2        |                  |
| $V_o$              | Output voltage noise                                                                       | Switching frequency<br>$V_{i\text{ nom}}, I_{o\text{ nom}}$<br>IEC/EN 61204                        |        | 15  | 35         |        | 25  | 45         |        | 40  | 70         | mV <sub>pp</sub> |
|                    |                                                                                            | Total<br>BW = 20 MHz                                                                               |        | 19  | 39         |        | 29  | 49         |        | 44  | 74         |                  |
| $\Delta V_{oV}$    | Static line regulation                                                                     | $V_{i\text{ min}} - V_{i\text{ max}}, I_{o\text{ nom}}$                                            |        | 20  | 45         |        | 30  | 55         |        | 50  | 75         | mV               |
| $\Delta V_{oI}$    | Static load regulation                                                                     | $V_{i\text{ nom}}, I_o = 0 - I_{o\text{ nom}}$                                                     |        | 20  | 35         |        | 25  | 40         |        | 30  | 65         |                  |
| $V_{oD}$           | Dynamic load regulation                                                                    | Voltage deviation<br>$V_{i\text{ nom}}$<br>$I_{o\text{ nom}} \leftrightarrow 1/3 I_{o\text{ nom}}$ |        | 100 |            |        | 100 |            |        | 100 |            | $\mu\text{s}$    |
| $t_d$              | Recovery time                                                                              | IEC/EN 61204                                                                                       |        | 50  |            |        | 50  |            |        | 60  |            |                  |
| $\alpha_{Vo}$      | Temperature coefficient<br>$\Delta V_o / \Delta T_C (T_{C\text{ min}} - T_{C\text{ max}})$ | $V_{i\text{ min}} - V_{i\text{ max}}$<br>$I_o = 0 - I_{o\text{ nom}}$                              |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ |        |     | $\pm 0.02$ | %/K              |



Table 3e: Output data. General conditions as per table 3a

| Output             |                                                                                                        |                   | PSB243                                                                             |       |           | PSB363 |            |       | PSB483 |            |       | Unit             |
|--------------------|--------------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------------------------------------------|-------|-----------|--------|------------|-------|--------|------------|-------|------------------|
| Characteristics    |                                                                                                        | Conditions        | min                                                                                | typ   | max       | min    | typ        | max   | min    | typ        | max   |                  |
| V <sub>o</sub>     | Output voltage                                                                                         |                   | V <sub>i nom</sub> , I <sub>o nom</sub>                                            | 23.86 | 24.14     | 35.78  |            | 36.22 | 47.71  |            | 48.29 | V                |
| I <sub>o nom</sub> | Output current nominal                                                                                 |                   | V <sub>i min</sub> – V <sub>i max</sub>                                            |       | 3.0       |        | 3.0        |       |        | 3.0        |       | A                |
| I <sub>o max</sub> | Output current max                                                                                     |                   | V <sub>i min</sub> – 80 V                                                          |       | 4.0       |        | 4.0        |       |        | 4.0        |       |                  |
| I <sub>oL</sub>    | Output current limitation                                                                              |                   | T <sub>C min</sub> – T <sub>C max</sub>                                            | 4.0   | 5.2       | 4.0    |            | 5.2   | 5.0    |            | 5.2   |                  |
| V <sub>o</sub>     | Output voltage noise                                                                                   | Switching freq.   | V <sub>i nom</sub> , I <sub>o nom</sub><br>IEC/EN 61204                            |       | 45    120 |        | 70    180  |       |        | 90    190  |       | mV <sub>pp</sub> |
|                    |                                                                                                        | Total             | BW = 20 MHz                                                                        |       | 50    125 |        | 75    185  |       |        | 95    195  |       |                  |
| ΔV <sub>oV</sub>   | Static line regulation                                                                                 |                   | V <sub>i min</sub> – V <sub>i max</sub> , I <sub>o nom</sub>                       |       | 70    150 |        | 100    200 |       |        | 150    300 |       | mV               |
| ΔV <sub>oI</sub>   | Static load regulation                                                                                 |                   | V <sub>i nom</sub> , I <sub>o</sub> = 0 – I <sub>o nom</sub>                       |       | 70    120 |        | 120    160 |       |        | 150    250 |       |                  |
| V <sub>o d</sub>   | Dynamic load                                                                                           | Voltage deviation | V <sub>i nom</sub><br>I <sub>o nom</sub> ↔ 1/3 I <sub>o nom</sub>                  |       | 120       |        | 140        |       |        | 150        |       |                  |
| t <sub>d</sub>     | regulation                                                                                             | Recovery time     | IEC/EN 61204                                                                       |       | 80        |        | 100        |       |        | 100        |       | μs               |
| α <sub>Vo</sub>    | Temperature coefficient<br>ΔV <sub>o</sub> /ΔT <sub>C</sub> (T <sub>C min</sub> – T <sub>C max</sub> ) |                   | V <sub>i min</sub> – V <sub>i max</sub><br>I <sub>o</sub> = 0 – I <sub>o nom</sub> |       | ±0.02     |        | ±0.02      |       |        | ±0.02      |       | %/K              |

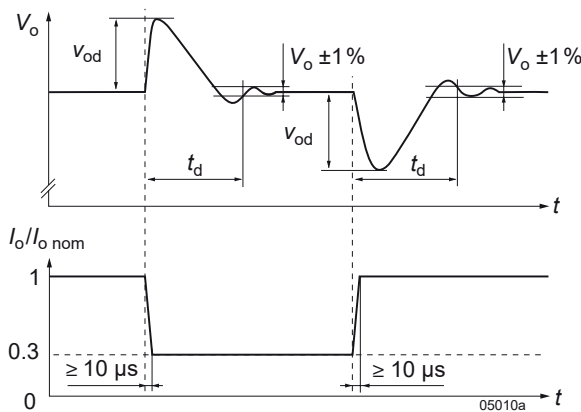


Fig. 3  
Switching regulator with long supply lines.

### Parallel and Series Connection

Outputs of equal nominal voltages can be parallel-connected. However, the use of a single regulator with higher output power, is always the 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 heat generation. Consequently, the max. ambient temperature should be reduced by 10 K.

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

### Thermal Considerations

When a switching regulator is located in free, quasi-stationary air (convection cooling) at a temperature  $T_A = 71\text{ °C}$  and is operated at  $I_{o\text{ nom}}$ , the case temperature  $T_C$  will be about  $95\text{ °C}$  after the warm-up phase, measured at the measuring point of case temperature  $T_C$ ; see *Mechanical Data*.

Under practical operating conditions,  $T_A$  may exceed  $71\text{ °C}$ , provided that additional measures (heat sink, fan, etc.) are taken to ensure that the case temperature  $T_C$  does not exceed  $T_{C\text{ max}}$ .

The regulators with  $V_{i\text{ max}} = 144\text{ V}$  withstand  $156\text{ V}$  for 2 s in order to comply with railway standards. However,  $I_{o\text{ max}}$  is only continuously available for  $V_i \leq 80\text{ V}$  or for reduced  $T_A$  and  $T_C$ ; see fig. 4c.



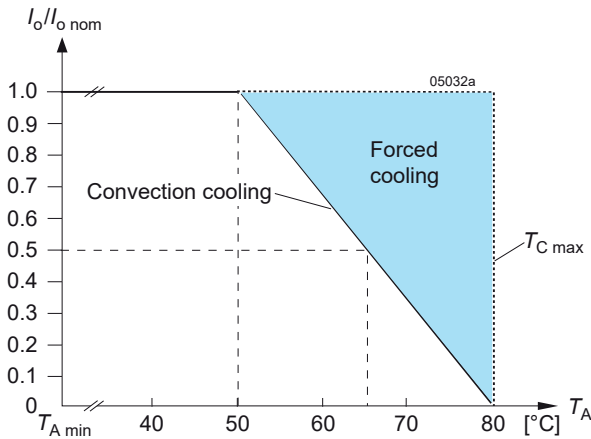


Fig. 4a  
Output current vs. temperature (models -2)

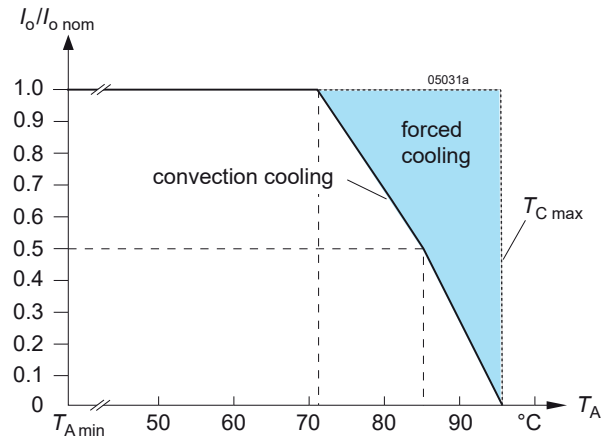


Fig. 4b  
Output current vs. temp (models -7 or -9 and with  $V_{i \max} \leq 80 \text{ V}$ )

For operation of regulators with  $V_{i \max} = 144 \text{ V}$  at  $T_A \geq 46^\circ\text{C}$ , an internal PTC (thermistor) starts reducing  $I_{oL}$ , if  $V_i$  is greater than  $80 \text{ V}$ . At most unfavorable conditions,  $I_{oL}$  is reduced by  $1 \text{ A}$ ; see fig. 5.

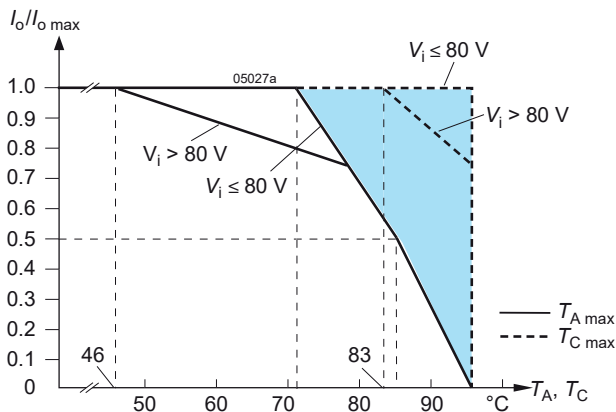


Fig. 4c  
Output current vs. temperature (models with  $V_{i \max} = 144 \text{ V}$ )

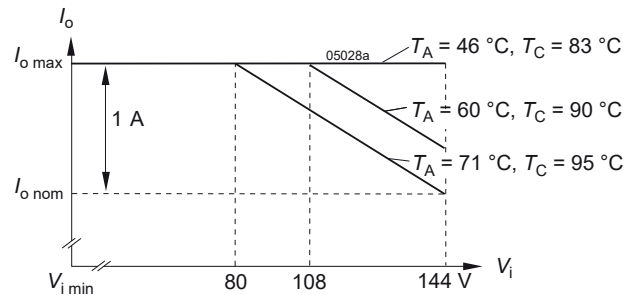


Fig. 5  
Typ. dependance of  $I_{oL}$  of temperature

### Output Protection and Short Circuit Behaviour

A voltage suppressor diode, which in worst case conditions fails into a short circuit (or a thyristor crowbar, option C), protects the output against an internally generated over-voltage. Such an overvoltage could occur due to a failure of either the control circuit or the switching transistor. The output protection is not designed to withstand externally applied overvoltages.

A constant current limitation circuit holds the output current almost constant, when an overload or a short circuit is applied to the output. It acts self-protecting and recovers automatically after removal of the overload or short circuit condition.

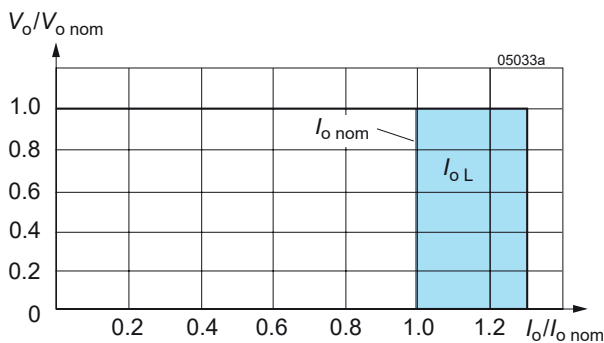


Fig. 6a  
Short-circuit behaviour  $V_o$  vs.  $I_o$  for regulators with  $V_{i \max} \leq 80 \text{ V}$

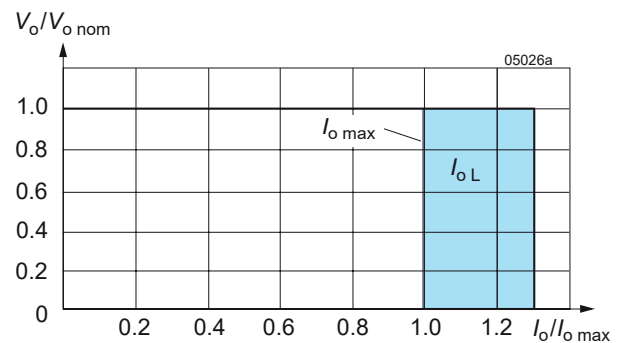


Fig. 6b  
Short-circuit behaviour  $V_o$  vs.  $I_o$  for regulators with  $V_{i \max} = 144 \text{ V}$ .

## Auxiliary Functions

### i Inhibit (Remote On / Off)

The inhibit input allows for disabling the switching regulator by a control signal. In systems with several converters, this feature can be used, for example, to control the activation sequence of converters by a logic signal. An output voltage overshoot will not occur at switch on.

**Note:** With open i-pin, the output is enabled.

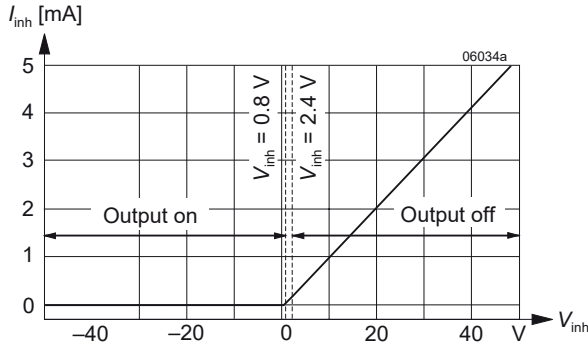


Fig. 7  
Typical inhibit current  $I_{inh}$  versus inhibit voltage  $V_{inh}$

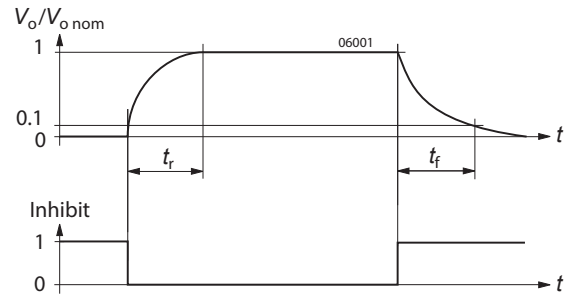


Fig. 8  
Output response as a function of inhibit signal

Table 4: Inhibit characteristics

| Characteristics |                              |                    | Conditions                                    | min  | typ | max  | Unit |
|-----------------|------------------------------|--------------------|-----------------------------------------------|------|-----|------|------|
| $V_{inh}$       | Inhibit input voltage        | $V_o = \text{on}$  | $V_{i \min} - V_{i \max}$                     | - 50 |     | +0.8 | V    |
|                 |                              | $V_o = \text{off}$ | $T_{C \min} - T_{C \max}$                     | +2.4 |     | +50  |      |
| $t_r$           | Switch-on time               |                    | $V_i = V_{i \text{ nom}}$                     |      | 130 |      | ms   |
| $t_f$           | Switch-off time              |                    | $R_L = V_{o \text{ nom}} / I_{o \text{ nom}}$ |      | 25  |      |      |
| $I_{inh}$       | Input current when inhibited |                    | $V_i = V_{i \text{ nom}}$                     |      | 25  |      | mA   |

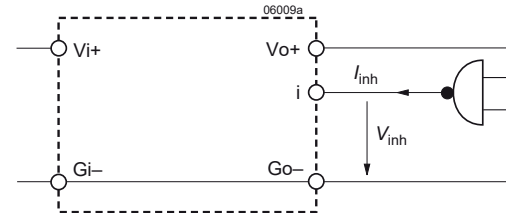


Fig. 9  
Definition of  $I_{inh}$  and  $V_{inh}$

### R Output Voltage Adjust

**Note:** With open R input,  $V_o \approx V_{o \text{ nom}}$ .

The output voltage  $V_o$  can either be adjusted with an external voltage source ( $V_{ext}$ ) or with an external resistor ( $R_1$  or  $R_2$ ). The adjustment range is 0 – 108% of  $V_{o \text{ nom}}$ . The minimum differential voltage  $\Delta V_{io \text{ min}}$  between input and output (see *Electrical Input Data*) should be maintained.

$$V_{ext} \approx 2.5 \text{ V} \cdot \frac{V_o}{V_{o \text{ nom}}} \quad V_o \approx V_{o \text{ nom}} \cdot \frac{V_{ext}}{2.5 \text{ V}}$$

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

b)  $V_o = 0$  to  $V_{o \text{ nom}}$ , using  $R_{ext1}$  between pins R and G:

$$R_{ext1} \approx \frac{4000 \Omega \cdot V_o}{V_{o \text{ nom}} - V_o} \quad V_o \approx \frac{V_{o \text{ nom}} \cdot R_{ext1}}{R_{ext1} + 4000 \Omega}$$

c)  $V_o = V_{o \text{ nom}}$  to  $V_{o \text{ max}}$ , using  $R_{ext2}$  between pins R and G:

$$R_{ext2} \approx \frac{4000 \Omega \cdot V_o \cdot (V_{o \text{ nom}} - 2.5 \text{ V})}{2.5 \text{ V} \cdot (V_o - V_{o \text{ nom}})}$$

$$V_o \approx \frac{V_{o \text{ nom}} \cdot 2.5 \text{ V} \cdot R_{ext2}}{2.5 \text{ V} \cdot (R_{ext2} + 4000 \Omega) - V_{o \text{ nom}} \cdot 4000 \Omega}$$

**Caution:** To prevent damage,  $R_{ext2}$  should never be less than 47 k $\Omega$ .

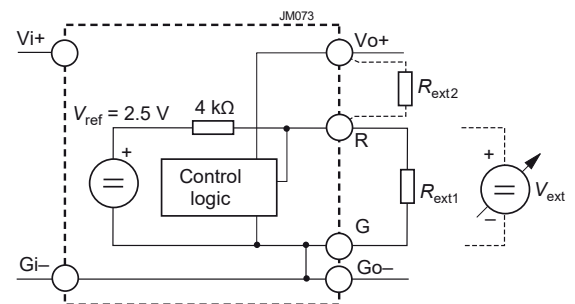


Fig. 10  
Output voltage adjustment via R-input

### LED Output Voltage Indicator

A yellow LED indicator is illuminated, when the output voltage is higher than approx. 3 V (not for -2 models).

## Electromagnetic Compatibility (EMC)

### Electromagnetic Immunity

Table 8: Electromagnetic immunity type tests

| Phenomenon                         | Standard         | Level          | Coupling mode <sup>1</sup> | Value applied         | Waveform                                                                                           | Source impeded. | Test procedure                                              | In oper. | Perf. crit. <sup>2</sup> |
|------------------------------------|------------------|----------------|----------------------------|-----------------------|----------------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|----------|--------------------------|
| Electrostatic discharge            | IEC/EN 61000-4-2 | 3 <sup>3</sup> | contact discharge          | 6000 V <sub>p</sub>   | 1/50 ns                                                                                            | 330 Ω           | 10 pos. & 10 neg. discharges                                | yes      | B                        |
|                                    |                  |                | air discharge              | 8000 V <sub>p</sub>   |                                                                                                    |                 |                                                             |          |                          |
| Electromagnetic field              | IEC/EN 61000-4-3 | x              | antenna                    | 20 V/m                | AM 80% / 1 kHz                                                                                     | N/A             | 80 – 1000 MHz                                               | yes      | A                        |
|                                    |                  |                |                            | 20 V/m                |                                                                                                    |                 | 800 – 1000 MHz                                              |          |                          |
|                                    |                  |                |                            | 10 V/m                |                                                                                                    |                 | 1400 – 2000 MHz                                             |          |                          |
|                                    |                  |                |                            | 5 V/m                 |                                                                                                    |                 | 2000 – 2500 MHz                                             |          |                          |
|                                    |                  |                |                            | 3 V/m                 |                                                                                                    |                 | 5100 – 6000 MHz                                             |          |                          |
| Electrical fast transients / burst | IEC/EN 61000-4-4 | 3 <sup>3</sup> | i/c, +i/-i                 | 2000 V <sub>p</sub>   | bursts of 5/50 ns;<br>5 kHz repet. rate;<br>transients with 15 ms burst duration;<br>300 ms period | 50 Ω            | 60 s positive<br>60 s negative transients per coupling mode | yes      | A <sup>4</sup>           |
| Surges                             | IEC/EN 61000-4-5 | 3 <sup>3</sup> | i/c                        | ± 2000 V <sub>p</sub> | 1.2 / 50 μs                                                                                        | 42 Ω<br>0.5 μF  | 5 pos. & 5 neg. surges per coupling mode                    | yes      | A <sup>4</sup>           |
|                                    |                  |                | +i/-i                      | ± 1000 V <sub>p</sub> |                                                                                                    |                 |                                                             |          |                          |
| Conducted disturbances             | IEC/EN 61000-4-6 | 3 <sup>3</sup> | i, o, signal wires         | 10 VAC <sup>3</sup>   | AM 80% / 1 kHz                                                                                     | 150 Ω           | 0.15 – 80 MHz                                               | yes      | A                        |

<sup>1</sup> i = input, o = output, c = case.

<sup>2</sup> A = Normal operation, no deviation from specifications, B = Normal operation, temporary loss of function or deviation from specs possible

<sup>3</sup> Not applicable for -2 models

<sup>4</sup> Option L necessary; with option C, manual reset might be necessary.

### Electromagnetic Emission

For emission levels refer to *Electrical Input Data*.

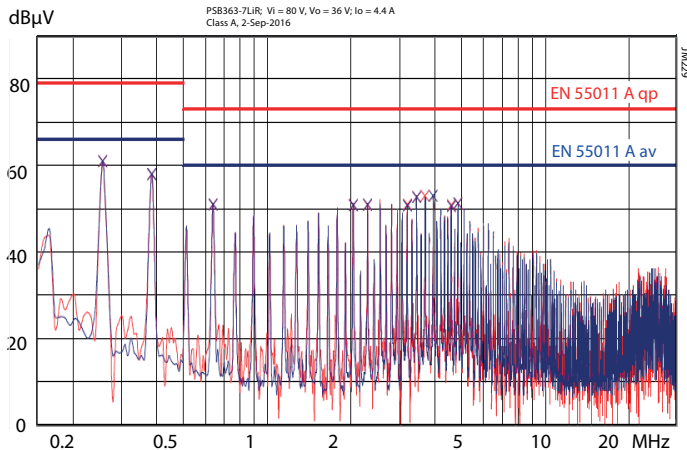


Fig. 11

Typical disturbance voltage (quasi-peak) at the input as per EN 55011, measured at V<sub>i nom</sub>, I<sub>o nom</sub>, PSB363-7LiR

## Immunity to Environmental Conditions

Table 6: Mechanical and climatic stress

| Test method |                                                    | Standard                                        | Test Conditions                                                     | Status                  |
|-------------|----------------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------|-------------------------|
| Cab         | Damp heat steady state                             | IEC/EN 60068-2-78<br>MIL-STD-810D section 507.2 | Temperature: 40 ±2 °C                                               | Regulator not operating |
|             |                                                    |                                                 | Relative humidity: 93 +2/-3 %                                       |                         |
|             |                                                    |                                                 | Duration: 56 days                                                   |                         |
| Ea          | Shock (half-sinusoidal)                            | IEC/EN 60068-2-27<br>MIL-STD-810D section 516.3 | Acceleration amplitude: 50 g <sub>n</sub> = 490 m/s <sup>2</sup>    | Regulator operating     |
|             |                                                    |                                                 | Bump duration: 11 ms                                                |                         |
|             |                                                    |                                                 | Number of bumps: 18 (3 in each direction)                           |                         |
| Fc          | Vibration (sinusoidal)                             | IEC/EN 60068-2-6<br>MIL-STD-810D section 514.3  | Acceleration amplitude: 0.35 mm (10 – 60 Hz)                        | Regulator operating     |
|             |                                                    |                                                 | 5 g <sub>n</sub> = 49 m/s <sup>2</sup> (60 - 2000 Hz)               |                         |
|             |                                                    |                                                 | Frequency (1 Oct/min): 10 – 2000 Hz                                 |                         |
|             |                                                    |                                                 | Test duration: 7.5 h (2.5 h in each axis)                           |                         |
| Fda         | Random vibration wide band<br>Reproducibility high | IEC/EN 60068-2-35<br>DIN 40046 part 23          | Acceleration spectral density: 0.05 g <sub>n</sub> <sup>2</sup> /Hz | Regulator operating     |
|             |                                                    |                                                 | Frequency band: 20 to 500 Hz                                        |                         |
|             |                                                    |                                                 | Acceleration magnitude: 4.9 g <sub>n rms</sub>                      |                         |
|             |                                                    |                                                 | Test duration: 3 h (1 h in each axis)                               |                         |
| Kb          | Salt mist cyclic (sodium chloride NaCl solution)   | IEC/EN 60068-2-52                               | Concentration: 5 % (30 °C)                                          | Regulator not operating |
|             |                                                    |                                                 | Duration: 2 h per cycle                                             |                         |
|             |                                                    |                                                 | Storage: 40 °C, 93% rel. humidity                                   |                         |
|             |                                                    |                                                 | Storage duration: 22 h per cycle                                    |                         |
|             |                                                    |                                                 | Number of cycles: 3                                                 |                         |

## Temperatures

Table 7: Temperature specifications, valid for air pressure of 800 to 1200 hPa (800 to 1200 mbar)

| Temperature                                     |                                  | -2   |     |     | -7   |     |     | -9 (Option) |     |     | Unit |
|-------------------------------------------------|----------------------------------|------|-----|-----|------|-----|-----|-------------|-----|-----|------|
| Characteristics                                 | Conditions                       | min  | typ | max | min  | typ | max | min         | typ | max |      |
| T <sub>A</sub> Ambient temperature <sup>1</sup> | Regulator operating <sup>1</sup> | - 10 |     | 50  | - 25 |     | 71  | - 40        |     | 71  | ° C  |
| T <sub>C</sub> Case temperature                 |                                  | - 10 |     | 80  | - 25 |     | 95  | - 40        |     | 95  |      |
| T <sub>S</sub> Storage temperature <sup>1</sup> | Not operational                  | - 25 |     | 100 | - 40 |     | 100 | - 55        |     | 85  |      |

<sup>1</sup> See *Thermal Considerations* and *Overttemperature Protection*.

## Reliability

Table 8: Typical MTBF and device hours

| MTBF                          | Ground benign          | Ground fixed           |                        | Ground mobile          | Device hours <sup>1</sup> |
|-------------------------------|------------------------|------------------------|------------------------|------------------------|---------------------------|
| Case temperature              | T <sub>c</sub> = 40 °C | T <sub>c</sub> = 40 °C | T <sub>c</sub> = 70 °C | T <sub>c</sub> = 50 °C |                           |
| MTBF accord. to MIL-HDBK-217F | 625 000 h              | 207 000 h              | 96 000 h               | 46 000 h               | 13 000 000 h              |

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

## Mechanical Data

Dimensions in mm.

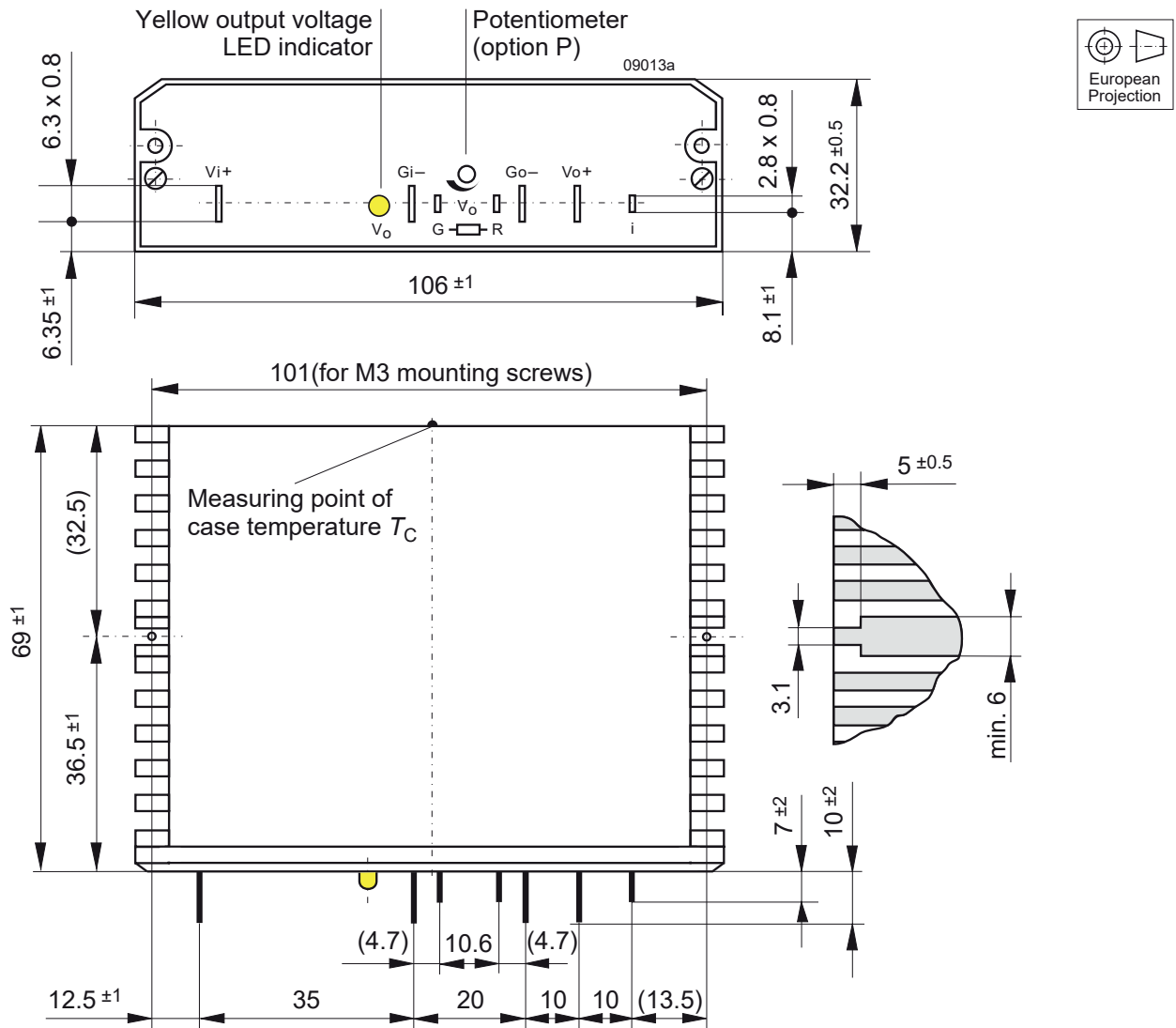


Fig. 12  
Case B02, weight 230 g  
Aluminum, black finish (EP powder coated), self cooling

## Safety and Installation Instructions

### Installation Instruction

Installation must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings, and segregation requirements of the end-use application.

Check for hazardous voltages before connecting.

The input and the output circuit are not separated, i.e., the negative path is internally interconnected.

Do not open the regulator !

Ensure that a regulator failure (e.g., by an internal short-circuit) does not result in a hazardous condition.

### Cleaning Liquids and Protection Degree

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

The protection degree is IP 30 (IP 20 with option P).

### Standards and Approvals

All switching regulators have been approved according to the latest edition of IEC/EN 62368-1 and UL/CSA60950-1.

The regulators have been evaluated for:

- Building in
- The use in a pollution degree 2 environment
- Connecting the input to a secondary circuit, which is subject to a maximum transient rating of 1500 V.

The switching regulators are subject to manufacturing surveillance in accordance with the above mentioned standards and with ISO 9001:2015.

### Isolation

Electric strength test voltage between input connected with output against case: 1500 VDC, 10 s (for some PSB models only with version V103 or higher).

These tests are performed in the factory as routine test in accordance with EN 62911 and IEC/EN 62368-1. The electric strength test should not be repeated by the customer.

### Railway Application

The regulators have been developed observing the railway standards EN 50155 and EN 50121. All boards are coated with a protective lacquer.

## Description of Options

### -9 Extended Temperature Range

This option defines an extended temperature range as specified in table 7.

### P Potentiometer

**Note:** Option P is not recommended, if several regulators are operated in parallel connection.

Option P excludes R function; the R-input (pin 16) should be left open-circuit. The output voltage  $V_o$  is preset to 108 % of  $V_{o\text{ nom}}$  and can be adjusted in the range 90 – 108% of  $V_{o\text{ nom}}$ .

However, the minimum differential voltage  $\Delta V_{i\text{ o min}}$  between input and output specified in *Electrical Input Data* should be observed.

### L Input Filter

Option L is recommended to reduce superimposed interference voltages and to prevent oscillations, if input lines exceed the length of approx. 5 m in total. 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 mVAC.

The input impedance of the switching regulator at 120 kHz is about 3.5  $\Omega$ . The harmonics are small in comparison with the fundamental wave.

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

$$V_{i\text{ max}} = 10 V_{pp} \text{ at } 100 \text{ Hz or } V_{pp} = 1000 \text{ Hz} / f_i \times 1 \text{ V}$$

### C Thyristor Crowbar

Option C protects the load against power supply malfunction. It is not designed to sink external currents. A fixed-value monitoring circuit checks the output voltage  $V_o$ . When the trigger voltage  $V_{o\text{ c}}$  (see table 9) is reached, the thyristor crowbar triggers and disables the output. It can be deactivated by removal of the input voltage. In case of a defect switching transistor, the internal fuse prevents excessive current.

Type of the fuse:

- Regulators with  $I_{o\text{ nom}} = 3 \text{ A}$ : 5 A / 250 V, slow, 5  $\times$  20 mm
- Regulators with  $I_{o\text{ nom}} > 3 \text{ A}$ : 8 A / 250 V, slow, 5  $\times$  20 mm

**Note:** The crowbar can be reset by removal of the input voltage only. The inhibit signal cannot deactivate the thyristor.

Table 9: Crowbar trigger levels

| Characteristics  |                 | Conditions                                                            | $V_o = 5.1 \text{ V}$ |     |     | $V_o = 12 \text{ V}$ |     |     | $V_o = 15 \text{ V}$ |     |     | $V_o = 24 \text{ V}$ |     |     | $V_o = 36 \text{ V}$ |     |     | Unit          |
|------------------|-----------------|-----------------------------------------------------------------------|-----------------------|-----|-----|----------------------|-----|-----|----------------------|-----|-----|----------------------|-----|-----|----------------------|-----|-----|---------------|
|                  |                 |                                                                       | min                   | typ | max | min                  | typ | max | min                  | typ | max | min                  | typ | max | min                  | typ | max |               |
| $V_{o\text{ c}}$ | Trigger voltage | $T_{C\text{ min}} - T_{C\text{ max}}$                                 | 5.8                   |     | 6.8 | 13.5                 |     | 16  | 16.5                 |     | 19  | 27                   |     | 31  | 40                   |     | 45  | V             |
| $t_s$            | Delay time      | $V_{i\text{ min}} - V_{i\text{ max}}$<br>$I_o = 0 - I_{o\text{ nom}}$ |                       |     | 1.5 |                      |     | 1.5 |                      |     | 1.5 |                      |     | 1.5 |                      |     | 1.5 | $\mu\text{s}$ |

### G RoHS Compliance

Models with G are RoHS-compliant for all six substances.



### Accessories

A variety of electrical and mechanical accessories are available, including:

- Insulation plate HZZ01205-G for easy and safe PCB-mounting; see fig. 13.
- Solder-tags for direct mounting of the regulator to a PCB board; see fig. 14.
- Ring core chokes for ripple and interference reduction.
- Battery sensor [S-KSMH...] for using the regulator as battery charger. Different cell characteristics can be selected; see Temperature Sensor Data Sheet BCD20024 on our web site.

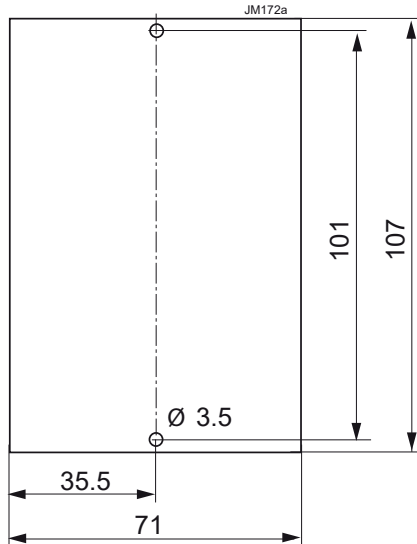


Fig. 13  
Insulation plate HZZ01205-G  
0.3 mm thick

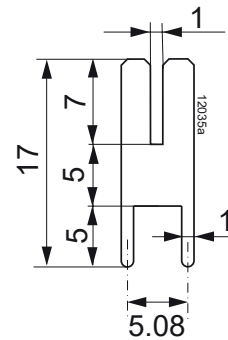


Fig. 14  
Solder tag HZZ01204-G  
Delivery content: 10 pieces

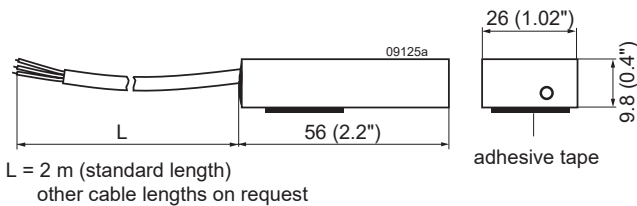


Fig. 15  
Battery temperature sensor

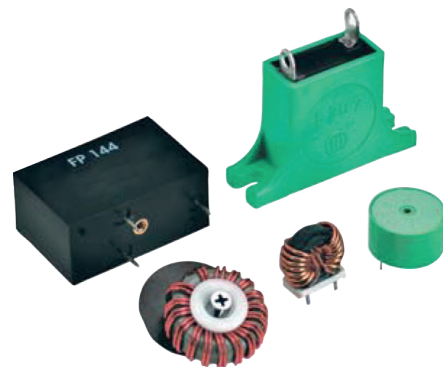


Fig. 16  
Different filters

**For additional accessory product information, see the accessory data sheets listed with each product series at our web site.**

**NUCLEAR AND MEDICAL APPLICATIONS** - These products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

**TECHNICAL REVISIONS** - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.

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