

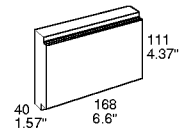
50 W DC-DC Converters

H-Family

Single output: series 12H/24H/48H1000
 Double output: series 12H/24H/48H2000
 Triple output: series 12H/24H/48H3000

- Wide input voltage range suitable for battery operation
- Efficient input filter and built-in surge and transient suppression circuitry
- 3 kV_{rms} input to output electric strength test
- Outputs individually isolated
- Outputs fully protected against overload

Safety according to IEC/EN 60950



7

Summary

The H-family of DC-DC converters represents a broad and flexible range of power supplies for use in advanced electronic systems. Features include high efficiency, reliability and reasonable output voltage noise.

The converter inputs are protected against surges and transients occurring at the source lines. An input over- and undervoltage cut-out circuitry disables the outputs if the input voltage is outside the specified range.

All outputs are open- and short-circuit proof and are protected against overvoltages by means of built-in suppressor diodes. The outputs can be inhibited by a logic signal applied to the connector pin 2 (i). If the inhibit function is not used pin 2 should be connected to pin 23 to enable the outputs.

LED indicators display the status of the converter and allow visual monitoring of the system at any time.

Full input to output, input to case, output to case and output to output isolation is provided. The modules are designed and built according to the international safety standard

IEC/EN 60950 and have been approved by the safety agencies LGA (Germany) and UL (USA). The UL Mark for Canada has been officially recognized by regulatory authorities in provinces across Canada.

The case design allows operation at nominal load up to 50°C in a free air ambient temperature. If forced cooling is provided, the ambient temperature may exceed 50°C but the case temperature should remain below 80°C under all conditions.

A temperature sensor generates an inhibit signal which disables the outputs if the case temperature T_c exceeds the limit. The outputs are automatically re-enabled when the temperature drops below the limit.

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

The modules may either be plugged into 19 inch rack systems according to DIN 41494, or be chassis mounted.

Table of Contents

| | Page | | Page |
|------------------------------------|-------|--|--------|
| Summary | 7 - 2 | Electromagnetic Compatibility (EMC) | 7 - 11 |
| Type Survey and Key Data | 7 - 3 | Mechanical Data | 7 - 12 |
| Type Key and Product Marking | 7 - 3 | Immunity to Environmental Conditions | 7 - 13 |
| Functional Description | 7 - 4 | Safety and Installation Instructions | 7 - 13 |
| Electrical Input Data | 7 - 5 | Description of Options | 7 - 16 |
| Electrical Output Data | 7 - 6 | Accessories | 7 - 20 |
| Auxiliary Functions | 7 - 9 | | |

Type Survey and Key Data

Table 1: Type survey

| Output 1 | | Output 2 | | Output 3 | | Input Voltage Range and Efficiency ¹ | | | | | Option | |
|------------------------------|---------------------------|------------------------------|---------------------------|------------------------------|---------------------------|---|----------------------------|--|----------------------------|--|--------|----------------------------|
| $U_{o\text{ nom}}$ [V DC] | $I_{o\text{ nom}}$ [A] | $U_{o\text{ nom}}$ [V DC] | $I_{o\text{ nom}}$ [A] | $U_{o\text{ nom}}$ [V DC] | $I_{o\text{ nom}}$ [A] | $U_{i\text{ min}} \dots U_{i\text{ max}}$ 8...15 V DC ² | η_{min} [%] | $U_{i\text{ min}} \dots U_{i\text{ max}}$ 14...30 V DC ² | η_{min} [%] | $U_{i\text{ min}} \dots U_{i\text{ max}}$ 28...60 V DC ² | | η_{min} [%] |
| 5.1 | 8.0 | - | - | - | - | 12H1001-2R | 73 | 24H1001-2R | 75 | 48H1001-2R | 76 | V2, V3 D1...D8 -7 |
| 12.0 | 4.0 | - | - | - | - | 12H1301-2R | 79 | 24H1301-2R | 82 | 48H1301-2R | 82 | |
| 15.0 | 3.4 | - | - | - | - | 12H1501-2R | 80 | 24H1501-2R | 82 | 48H1501-2R | 83 | |
| 24.0 | 2.0 | - | - | - | - | 12H1601-2R | 81 | 24H1601-2R | 83 | 48H1601-2R | 85 | |
| 48.0 | 1.0 | - | - | - | - | 12H1901-2R ² | 83 | 24H1901-2R ² | 85 | 48H1901-2R ² | 86 | |
| 12.0 | 2.0 | 12.0 | 2.0 | - | - | 12H2320-2 | 79 | 24H2320-2 | 80 | 48H2320-2 | 82 | |
| 15.0 | 1.7 | 15.0 | 1.7 | - | - | 12H2540-2 | 80 | 24H2540-2 | 81 | 48H2540-2 | 83 | |
| 5.1 | 5.0 | 12.0 | 0.7 | 12.0 | 0.7 | 12H3020-2 | 77 | 24H3020-2 | 78 | 48H3020-2 | 79 | |
| 5.1 | 5.0 | 15.0 | 0.6 | 15.0 | 0.6 | 12H3040-2 | 77 | 24H3040-2 | 79 | 48H3040-2 | 80 | |

¹ Efficiency measured at $U_{i\text{ nom}}$ and $I_{o\text{ nom}}$

² Input voltage range 12H1901-2R: 9...15 V DC, 24H1901-2R: 18...30 V DC, 48H1901-2R: 36...60 V DC

Type Key and Product Marking

Type Key

| | | | |
|---|----------------------|-------|----|
| Input voltage range U_i : | 8...15 V DC | ..... | 12 |
| | 14...30 V DC | ..... | 24 |
| | 28...60 V DC | ..... | 48 |
| Family | H | | |
| Number of outputs | 1...3 | | |
| Output 1, $U_{o1\text{ nom}}$: | 5.1 V | ..... | 0 |
| | 12 V | ..... | 3 |
| | 15 V | ..... | 5 |
| | 24 V | ..... | 6 |
| | 48 V | ..... | 9 |
| Single output modules | 01 | | |
| Output 2 and 3, $U_{o2\text{ nom}}$, $U_{o3\text{ nom}}$: | 12 V | ..... | 20 |
| | 15 V | ..... | 40 |
| Options and features: | | | |
| Ambient temperature range T_A -10...50°C | -2 | | |
| Extended temperature range T_A -25...71°C | -7 | | |
| Output voltage control input (single output modules only) | R | | |
| Save data signal (D1...D8, to be specified) | D ¹ | | |
| ACFAIL signal (V2, V3, to be specified) | V ¹ | | |

¹ Option D excludes option V and vice versa

Example: 48H1501-2RD3: DC-DC converter, input voltage range 28...60 V, providing output with 15 V/3.4 A; equipped with an output voltage control input and undervoltage monitoring.

Product Marking (refer also to *Mechanical Data*)

- Main face: Basic type designation, applicable safety approval and recognition marks, CE mark, warnings, pin allocation, Melcher patents and company logo.
- Front plate: Identification of LEDs and potentiometer.
- Back plate: Specific type designation, input voltage range, nominal output voltage(s) and current(s), pin allocation of options and auxiliary functions, external fuse specification and degree of protection.
- Rear face: Label with batch no., serial no. and data code including production site, modification status and date of production. Confirmation of successfully passed final test.

Functional Description

The input voltage is fed via an input filter to the input capacitor. This capacitor sources a single transistor forward converter. Each output is powered by a separate secondary winding of the main transformer. The resultant voltages are rectified and their ripples smoothed by a power choke. The control logic senses the main output voltage U_{o1} and generates, with respect to the maximum admissible output currents, the control signal for the primary switching transistor.

This signal is fed back via a coupling transformer.

The auxiliary outputs U_{o2} and U_{o3} are unregulated. Each auxiliary output's current is sensed and transferred to the main control circuit using a current transformer. If one of the outputs is driven into current limit, the other outputs will reduce their output voltages as well because all output currents are controlled by the same control circuit.

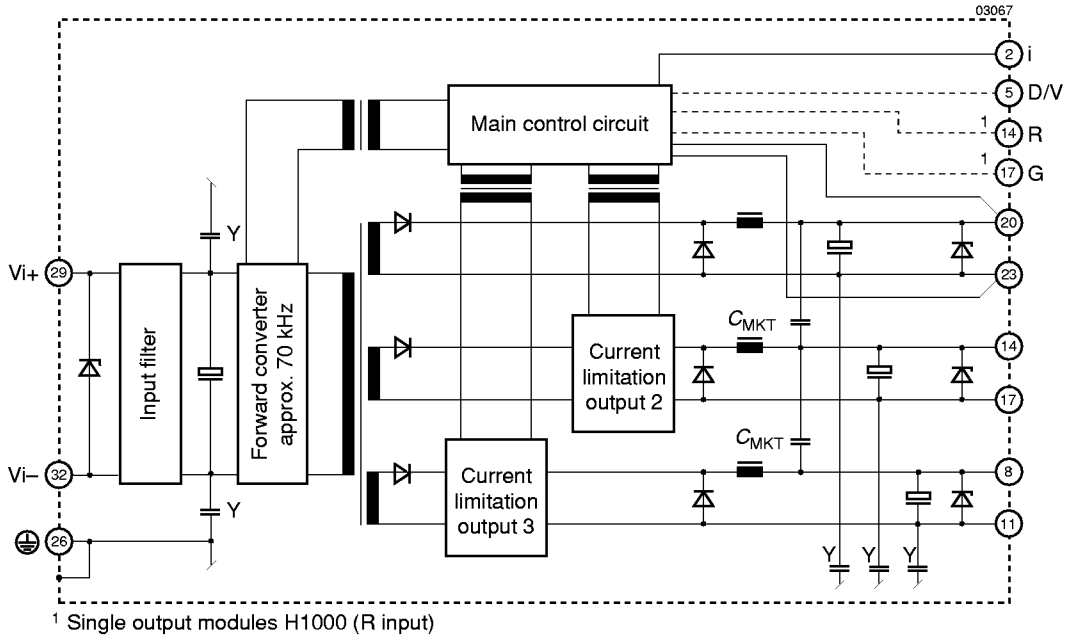


Fig. 1
DC-DC converter block diagram

Electrical Input Data

General conditions:

- $T_A = 25^\circ\text{C}$, unless T_C is specified.
- Connector pins 2 and 23 interconnected, R input not connected.

Table 2: Input data

| Input | | | 12H | | | 24H | | | 48H | | | | | | | |
|-------------------------|---|--|------|-----|-----|------|-----|-----|-----|-----|-----|------------------|---------------|--|----|------|
| Characteristics | | Conditions | min | typ | max | min | typ | max | min | typ | max | Unit | | | | |
| U_i | Operating input voltage ..H1901-2R | $I_o = 0 \dots I_{o, \text{nom}}$ $T_C \text{ min} \dots T_C \text{ max}$ | 8 | | 15 | 14 | | 30 | 28 | | 60 | V DC | | | | |
| | | | 9 | | 15 | 18 | | 30 | 36 | | 60 | | | | | |
| $U_{i, \text{nom}}$ | Nominal input voltage | | 12 | | | 24 | | | 48 | | | | | | | |
| I_i | Input current | $U_{i, \text{nom}}, I_{o, \text{nom}}^1$ | 5.0 | | | 2.5 | | | 1.3 | | | A | | | | |
| P_{i0} | No-load input power: Single output Double output Triple output | $U_{i, \text{nom}}$ $I_{o1,2,3} = 0$ | 1 | 1.5 | | 1 | 1.5 | | 1 | 1.5 | | W | | | | |
| | | | 4 | 6 | | 4 | 6 | | 4 | 6 | | | | | | |
| | | | 4 | 6 | | 4 | 6 | | 4 | 6 | | | | | | |
| $P_{i, \text{inh}}$ | Idle input power | inhibit mode | 2 | | | 2 | | | 2 | | | | | | | |
| $I_{i, \text{inr p}}^3$ | Peak inrush current | $U_i = U_{i, \text{max}}$ $R_S = 0 \Omega^2$ $T_C = 25^\circ\text{C}$ | 380 | | | 380 | | | 350 | | | A | | | | |
| $t_{i, \text{inr r}}$ | Rise time | $T_C = 25^\circ\text{C}$ | 60 | | | 50 | | | 20 | | | μs | | | | |
| $t_{i, \text{inr h}}$ | Time to half value | | 110 | | | 75 | | | 40 | | | | | | | |
| R_i | Input resistance | $T_C = 25^\circ\text{C}$ | 40 | | | 80 | | | 175 | | | $\text{m}\Omega$ | | | | |
| C_i | Input capacitance | | 2200 | | | 3300 | | | 750 | | | 1200 | μF | | | |
| $U_{i, \text{abs}}$ | Input voltage limits without any damage | | 0 | | | 20 | | | 0 | | | 40 | | | 80 | V DC |

¹ With multiple output modules, the same condition for each output applies.

² R_S = source resistance

³ $I_{i, \text{inr p}} = U_i / (R_S + R_i)$

Input Under-/Overvoltage Lock-out

If the input voltage remains below $0.8 U_{i, \text{min}}$ or exceeds $1.1 U_{i, \text{max}}$ (approx. values), an internally generated inhibit signal disables the output(s). When checking this function the absolute maximum input voltage rating $U_{i, \text{abs}}$ must be carefully considered (see table *Electrical Input Data*).

Reverse Polarity

The unit is not protected against reverse polarity at the input. (Reverse polarity will cause the external fuse to blow.)

Input Fuse

The modules do not incorporate any fuse. External fuses installed in the wiring to the inputs are essential.

Table 3: Recommended fuse types

| Series | Schurter type | | Part number |
|--------|---------------|--------------|-------------|
| 12H | SPT | 10 A 250 V | 0001.2514 |
| 24H | SPT | 8 A 250 V | 0001.2513 |
| 48H | SPT | 3.15 A 250 V | 0001.2509 |

Electrical Output Data

General conditions

– $T_A = 25^\circ\text{C}$, unless T_C is specified.

– Connector pins 2 and 23 interconnected, R input not connected.

Table 4a: Output data

| Output | | Conditions | 5.1 V | | | 12 V | | | 15 V | | | Unit |
|-----------------------|---|--|---|----------|---|----------|---|----------|---|-----|------------------|------|
| Characteristics | | | min | typ | max | min | typ | max | min | typ | max | |
| U_{o1} | Output voltage | $U_{i\text{ nom}}, I_{o\text{ nom}}^1$ | 5.00 | | 5.20 | 11.76 | | 12.24 | 14.70 | | 15.30 | V |
| $U_{o2/3}$ | | | - | | | 11.10 | | 12.90 | 13.90 | | 16.10 | |
| $U_{o2/3\ 0}$ | | $U_{i\text{ min}} \dots U_{i\text{ max}}$ $I_{o2/3} = 0$ | - | | | | | 13.80 | | | 17.25 | |
| $U_{o1\ P}$ | Output overvoltage protection | | 7.5 | | | 21 | | | 25 | | | |
| $U_{o2/3\ P}$ | | | - | | | 25 | | | 31 | | | |
| $I_{o\text{ nom}}$ | Output current | $U_{i\text{ min}} \dots U_{i\text{ max}}$ | see Type Survey and Key Data | | | | | | | | | |
| $I_{o\ L}$ | Output current limitation response | $T_C\text{ min} \dots T_C\text{ max}$ | see fig. Typical output voltage U_{o1} versus output currents I_o | | | | | | | | | |
| $u_{o1/2/3}$ | Output voltage noise | Switch. freq. | $U_{i\text{ nom}}, I_{o\text{ nom}}^1$ | | 30 | 50 | 60 | 100 | 50 | 80 | mV _{pp} | |
| | | Total | IEC/EN 61204 BW = 20 MHz | | 60 | 200 | 70 | 200 | 75 | 200 | | |
| $\Delta U_{o1\ U}$ | Static line regulation | $U_{i\text{ min}} \dots U_{i\text{ nom}}$ $U_{i\text{ nom}} \dots U_{i\text{ max}}$ $I_{o\text{ nom}}^1$ | | | ± 50 | | ± 100 | | ± 100 | | mV | |
| $\Delta U_{o2/3\ U}$ | | | | | | | ± 150 | | ± 150 | | | |
| $\Delta U_{o1\ I}$ | Static load regulation | $U_{i\text{ nom}}$ $I_o = I_{o\text{ nom}} \dots 0^2$ | | | 50 | | 150 | | 150 | | | |
| $\Delta U_{o2/3\ I}$ | | | | | | | see H2320/H3020 = $\Delta U_{o\ 2/3}$ vers. $I_{o\ 2/3}$ | | see H2540/H3040 = $\Delta U_{o\ 2/3}$ vers. $I_{o\ 2/3}$ | | | |
| $\Delta U_{o1\ Ic}$ | Static cross load regulation ³ | $U_{i\text{ nom}}$ $I_o = I_{o\text{ nom}} \dots 0^4$ | ± 5 | ± 15 | ± 10 | ± 30 | ± 15 | ± 45 | | | | |
| $\Delta U_{o2/3\ Ic}$ | | | | | see H2320/H3020 = $\Delta U_{o\ 2/3}$ vers. $I_{o\ 2/3}$ | | see H2540/H3040 = $\Delta U_{o\ 2/3}$ vers. $I_{o\ 2/3}$ | | | | | |

Table 4b: Output data

| Output | | Conditions | 24 V | | | 48 V | | | Unit |
|---------------------|------------------------------------|---|--|-----|-----------|-------|-----------|-------|------------------|
| Characteristics | | | min | typ | max | min | typ | max | |
| U_{o1} | Output voltage | $U_{i\text{ nom}}, I_{o1\text{ nom}}$ | 23.52 | | 24.48 | 47.04 | | 48.96 | V |
| $U_{o\ P}$ | Overvoltage prot. | | 41 | | | 85 | | | |
| $I_{o1\text{ nom}}$ | Output current | $U_{i\text{ min}} \dots U_{i\text{ max}}$ | see Type Survey and Key Data | | | | | | |
| $I_{o1\ L}$ | Output current limitation response | $T_C\text{ min} \dots T_C\text{ max}$ | see Typical output voltage U_{o1} versus output currents I_o | | | | | | |
| $u_{o1/2/3}$ | Output voltage noise | Switch. freq. | $U_{i\text{ nom}}, I_{o\text{ nom}}^1$ | | 30 | 50 | 20 | 40 | mV _{pp} |
| | | Total | IEC/EN 61204 BW = 20 MHz | | 75 | 200 | 35 | 150 | |
| $\Delta U_{o1\ U}$ | Static line regulation | $U_{i\text{ min}} \dots U_{i\text{ nom}}$ $U_{i\text{ nom}} \dots U_{i\text{ max}}$ $I_{o1\text{ nom}}$ | | | ± 150 | | ± 150 | | mV |
| $\Delta U_{o1\ I}$ | Static load regulation | $U_{i\text{ nom}}$ $I_{o1} = I_{o1\text{ nom}} \dots 0$ | | | 150 | | 150 | | |

¹ With multiple output modules, the same condition for each output applies.

² Condition for specified output. With multiple output modules, other output(s) loaded with constant current $I_o = I_{o\text{ nom}}$.

³ Condition for non-specified output, individually tested, other output(s) loaded with constant current $I_o = I_{o\text{ nom}}$.

⁴ Multiple output modules.

Output Protection

Each output is protected against overvoltages which could occur due to a failure of the internal control circuit. Voltage suppressor diodes (which under worst case condition may become a short circuit) provide the required protection. The suppressor diodes are not designed to withstand externally applied overvoltages. Overload at any of the outputs will cause a shut-down of all outputs.

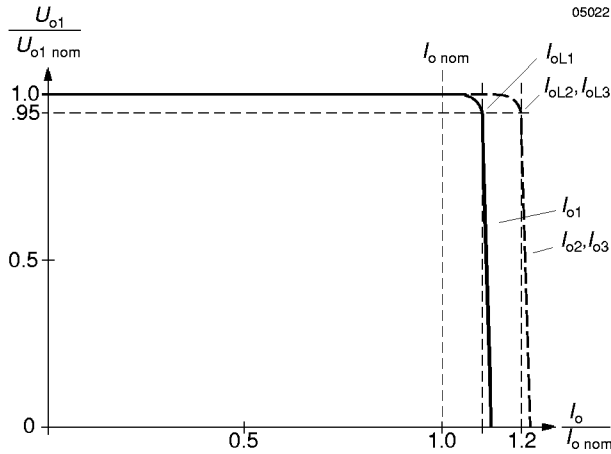


Fig. 2
Typical output voltage U_{o1} versus output currents I_o

Parallel and Series Connection

Main outputs of equal nominal voltage can be connected in parallel. It is important to assure that the main output of a multiple output module is forced to supply a minimum current of 0.1 A to enable correct operation of its own auxiliary outputs.

Outputs one and two of a double output unit may be connected in parallel without a minimum current requirement at the main output. Outputs two and three of a triple output unit can be connected in parallel.

In parallel operation, one or more of the main outputs may operate continuously in current limitation which will cause an increase in case temperature. Consequently, a reduction of the max. ambient temperature by 10 K is recommended.

Main or auxiliary outputs can be connected in series with any other output of the same or another module. In series connection, the maximum output current is limited by the lowest current limit. Output ripple and regulation values are added. Connection wiring should be kept as short as possible.

If output terminals are connected together in order to establish multi-voltage configurations, e.g. +5.1 V, ± 12 V etc. the common ground connecting point should be as close as possible to the connector of the converter to avoid excessive output ripple voltages.

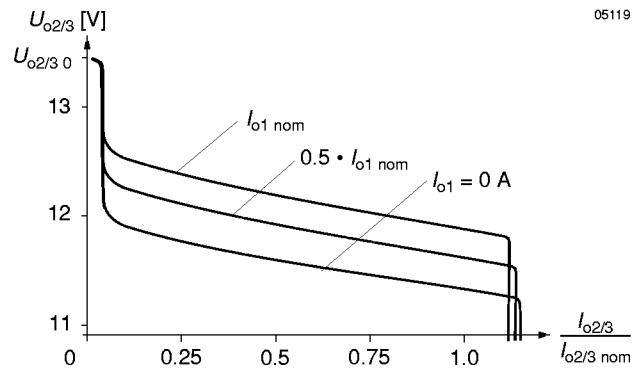


Fig. 3
H2320/H3020: $\Delta U_{o2/3}$ (typ.) versus $I_{o2/3}$ with different I_{o1}

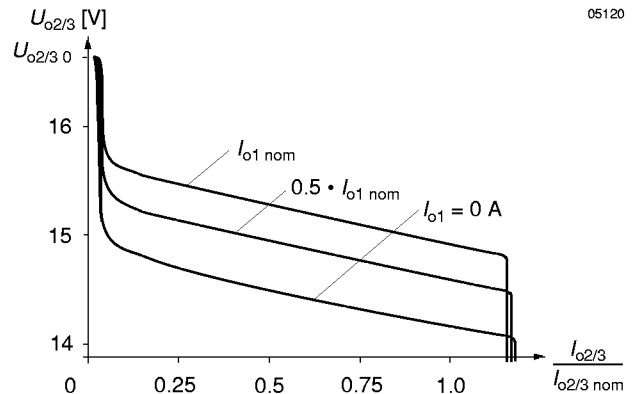


Fig. 4
H2540/H3040: $\Delta U_{o2/3}$ (typ.) versus $I_{o2/3}$ with different I_{o1}

Thermal Considerations

If a converter is located in free, quasi-stationary air (convection cooling) at the indicated maximum ambient temperature $T_{A \max}$ (see table *Temperature specifications*) and is operated at its nominal input voltage and output power, the temperature measured at the *Measuring point of case temperature* T_C (see *Mechanical Data*) will approach the indicated value $T_{C \max}$ after the warm-up phase. However, the relationship between T_A and T_C depends heavily on the conditions of operation and integration into a system. The thermal conditions are influenced by input voltage, output current, airflow and temperature of surrounding components and surfaces. $T_{A \max}$ is therefore, contrary to $T_{C \max}$, an indicative value only.

Caution: The installer must ensure that under all operating conditions T_C remains within the limits stated in the table *Temperature specifications*.

Notes: Sufficient forced cooling or an additional heat sink allows T_A to be higher than 50°C (e.g. 65°C) if $T_{C \max}$ is not exceeded.

For -2 units at an ambient temperature T_A of 65°C with only convection cooling, the maximum permissible current for each output is approx. 50% of its nominal value as per figure.

Output Response

The reaction of the outputs is similar whether the input voltage is applied or the inhibit is switched low. An output voltage overshoot will not occur when the module is turned on or off.

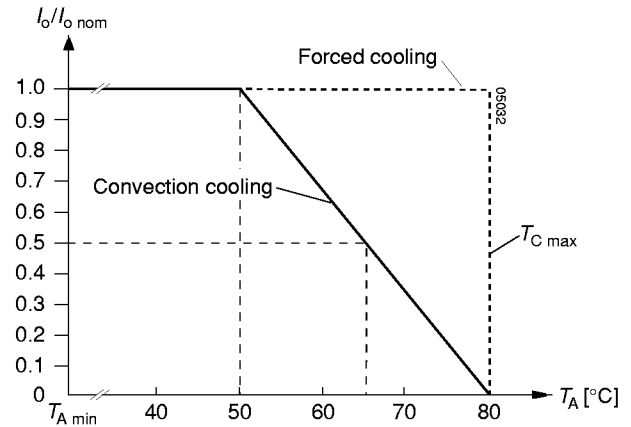


Fig. 5 Output current derating versus temperature for -2 units.

Thermal Protection

A temperature sensor generates an internal inhibit signal which disables the outputs if the case temperature exceeds $T_{C \max}$. The outputs are automatically re-enabled if the temperature drops below this limit.

Fig. 6 Output response as a function of input voltage (on/off switching) or inhibit control

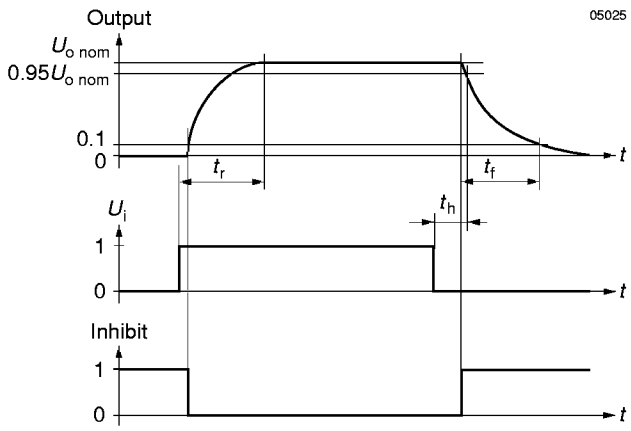


Table 5: Output response time t_r and t_f

| Type of Converter | t_r at $P_o = 0$ and t_f at $P_o = P_o \text{ nom}$ | | t_r and t_f at $P_o = \frac{3}{4} P_o \text{ nom}$ | | t_r at $P_o = P_o \text{ nom}$ | | Unit |
|-------------------|---|-----|--|-----|----------------------------------|-----|------|
| | typ | max | typ | max | typ | max | |
| H1001-2R | 3 | 7 | 3 | 7 | 5 | 15 | ms |
| H1301-2R | 5 | 15 | 8 | 20 | 10 | 30 | |
| H1501-2R | 3 | 7 | 5 | 15 | 15 | 40 | |
| H1601-2R | 8 | 20 | 15 | 35 | 20 | 60 | |
| H1901-2R | 35 | 90 | 50 | 140 | 85 | 220 | |
| H2320-2 | 10 | 30 | 15 | 40 | 25 | 70 | |
| H2540-2 | 8 | 20 | 10 | 30 | 20 | 50 | |
| H3020-2 | 30 | 75 | 45 | 120 | 75 | 200 | |
| H3040-2 | 20 | 60 | 30 | 80 | 50 | 140 | |

Conditions: R input not used. For multiple output modules the figures indicated in the table above relate to the output which reacts slowest. All outputs are resistively loaded. Variation of the input voltage within $U_{i \min} \dots U_{i \max}$ does not influence the values.

Auxiliary Functions

i Inhibit for Remote On and Off

Note: With open i input: Output is disabled ($U_o = \text{off}$).

The outputs of the module may be enabled or disabled by means of a logic signal (TTL, CMOS, etc.) applied between the inhibit input i and the negative pin of output 1 ($Vo1-$). In systems with several units, this feature can be used, for example, to control the activation sequence of the converters. If the inhibit function is not required, connect the inhibit pin 2 to pin 23 to enable the outputs (active low logic, fail safe). For output response refer to *Output Response*.

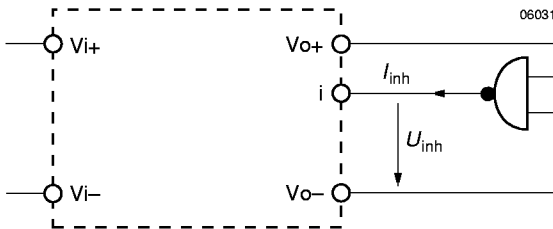


Fig. 7
Definition of U_{inh} and I_{inh} .

Table 6: Inhibit data

| Characteristics | | Conditions | min | typ | max | Unit |
|-----------------|--|--------------------|-----|------|------|---------------|
| U_{inh} | Inhibit input voltage to keep output voltage | $U_o = \text{on}$ | -50 | | 0.8 | V DC |
| | | $U_o = \text{off}$ | 2.4 | | 50 | |
| I_{inh} | Inhibit current | $U_{inh} = 0$ | -60 | -100 | -220 | μA |

R-Control for Output Voltage Adjustment

Note: With open R input, $U_o \approx U_{o \text{ nom}}$.

As a standard feature, single output modules offer an adjustable output voltage identified by letter R in the type designation.

The output voltage U_{o1} can either be adjusted with an external voltage (U_{ext}) or with an external resistor (R_1 or R_2). The adjustment range is approximative 0...110% of $U_{o \text{ nom}}$. For output voltages $U_o > U_{o \text{ nom}}$, the minimum input voltage according to *Electrical Input Data* increases proportionally to $U_o/U_{o \text{ nom}}$.

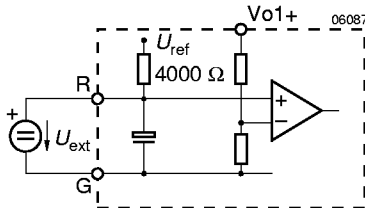


Fig. 9
Voltage adjustment with external voltage U_{ext}

a) $U_o \approx 0...110\% U_{o \text{ nom}}$, using U_{ext} between R (14) and G (17):

$$U_{ext} \approx 2.5 \text{ V} \cdot \frac{U_o}{U_{o \text{ nom}}} \quad U_o \approx U_{o \text{ nom}} \cdot \frac{U_{ext}}{2.5 \text{ V}}$$

Caution: To prevent damage, U_{ext} should not exceed 8 V, nor be negative.

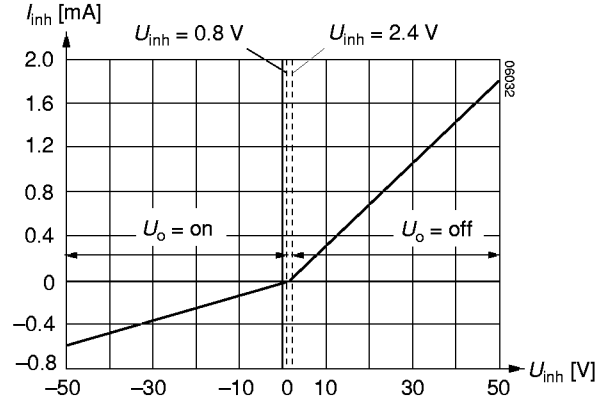


Fig. 8
Typical inhibit current I_{inh} versus inhibit voltage U_{inh}

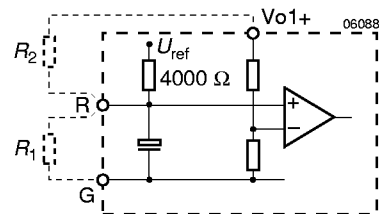


Fig. 10
Voltage adjustment with external resistor R_1 or R_2

b) $U_o \approx 0...100\% U_{o \text{ nom}}$, using R_1 between R (14) and G (17):

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

c) $U_o \approx U_{o \text{ nom}}...U_{o \text{ max}}$, using R_2 between R (14) and Vo1+ (20):

$$U_{o \text{ max}} = U_{o \text{ nom}} + 10\%$$

$$R_2 \approx \frac{4000 \Omega \cdot U_o \cdot (U_{o \text{ nom}} - 2.5 \text{ V})}{2.5 \text{ V} \cdot (U_o - U_{o \text{ nom}})}$$

$$U_o \approx \frac{U_{o \text{ nom}} \cdot 2.5 \text{ V} \cdot R_2}{2.5 \text{ V} \cdot (R_2 + 4000 \Omega) - U_{o \text{ nom}} \cdot 4000 \Omega}$$

Caution: To prevent damage, R_2 should never be less than 47 k Ω .

Note: R inputs of n units with paralleled outputs may be paralleled, too, but if only one external resistor is to be used, its value should be R_1/n , or R_2/n respectively.

Table 7a: R_1 for $U_o < U_{o\ nom}$ (conditions: $U_{i\ nom}$, $I_o\ nom$, rounded up to resistor values E 96); $R_2 = \infty$

| $U_{o\ nom} = 5.1\ V$ | | $U_{o\ nom} = 12\ V$ | | $U_{o\ nom} = 15\ V$ | | $U_{o\ nom} = 24\ V$ | | $U_{o\ nom} = 48\ V$ | |
|-----------------------|------------------|----------------------|------------------|----------------------|------------------|----------------------|------------------|----------------------|------------------|
| $U_o\ [V]$ | $R_1\ [k\Omega]$ | $U_o\ [V]$ | $R_1\ [k\Omega]$ | $U_o\ [V]$ | $R_1\ [k\Omega]$ | $U_o\ [V]$ | $R_1\ [k\Omega]$ | $U_o\ [V]$ | $R_1\ [k\Omega]$ |
| 0.5 | 0.432 | 2.0 | 0.806 | 2.0 | 0.619 | 4.0 | 0.806 | 8.0 | 0.806 |
| 1.0 | 0.976 | 3.0 | 1.33 | 4.0 | 1.47 | 6.0 | 1.33 | 12.0 | 1.33 |
| 1.5 | 1.65 | 4.0 | 2.0 | 6.0 | 2.67 | 8.0 | 2.0 | 16.0 | 2.0 |
| 2.0 | 2.61 | 5.0 | 2.87 | 8.0 | 4.53 | 10.0 | 2.87 | 20.0 | 2.87 |
| 2.5 | 3.83 | 6.0 | 4.02 | 9.0 | 6.04 | 12.0 | 4.02 | 24.0 | 4.02 |
| 3.0 | 5.76 | 7.0 | 5.62 | 10.0 | 8.06 | 14.0 | 5.62 | 28.0 | 5.62 |
| 3.5 | 8.66 | 8.0 | 8.06 | 11.0 | 11.0 | 16.0 | 8.06 | 32.0 | 8.06 |
| 4.0 | 14.7 | 9.0 | 12.1 | 12.0 | 16.2 | 18.0 | 12.1 | 36.0 | 12.1 |
| 4.5 | 30.1 | 10.0 | 20.0 | 13.0 | 26.1 | 20.0 | 20.0 | 40.0 | 20.0 |
| 5.0 | 200.0 | 11.0 | 44.2 | 14.0 | 56.2 | 22.0 | 44.2 | 44.0 | 44.2 |

Table 7b: R_2 for $U_o > U_{o\ nom}$ (conditions: $U_{i\ nom}$, $I_o\ nom$, rounded up to resistor values E 96); $R_1 = \infty$

| $U_{o\ nom} = 5.1\ V$ | | $U_{o\ nom} = 12\ V$ | | $U_{o\ nom} = 15\ V$ | | $U_{o\ nom} = 24\ V$ | | $U_{o\ nom} = 48\ V$ | |
|-----------------------|------------------|----------------------|------------------|----------------------|------------------|----------------------|------------------|----------------------|------------------|
| $U_o\ [V]$ | $R_2\ [k\Omega]$ | $U_o\ [V]$ | $R_2\ [k\Omega]$ | $U_o\ [V]$ | $R_2\ [k\Omega]$ | $U_o\ [V]$ | $R_2\ [k\Omega]$ | $U_o\ [V]$ | $R_2\ [k\Omega]$ |
| 5.15 | 464 | 12.1 | 1780 | 15.2 | 1470 | 24.25 | 3160 | 48.5 | 6810 |
| 5.20 | 215 | 12.2 | 909 | 15.4 | 750 | 24.50 | 1620 | 49.0 | 3480 |
| 5.25 | 147 | 12.3 | 619 | 15.6 | 511 | 24.75 | 1100 | 49.5 | 2370 |
| 5.30 | 110 | 12.4 | 464 | 15.8 | 383 | 25.00 | 825 | 50.0 | 1780 |
| 5.35 | 90.9 | 12.5 | 383 | 16.0 | 332 | 25.25 | 715 | 50.5 | 1470 |
| 5.40 | 78.7 | 12.6 | 316 | 16.2 | 274 | 25.50 | 590 | 51.0 | 1270 |
| 5.45 | 68.1 | 12.7 | 274 | 16.4 | 237 | 25.75 | 511 | 51.5 | 1100 |
| 5.50 | 61.9 | 12.8 | 249 | 16.5 | 226 | 26.00 | 453 | 52.0 | 953 |
| | | 13.0 | 200 | | | 26.25 | 402 | 52.5 | 845 |
| | | 13.2 | 169 | | | 26.40 | 383 | 52.8 | 806 |

Display Status of LEDs

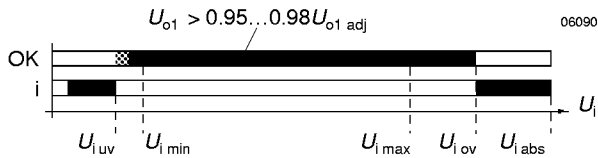
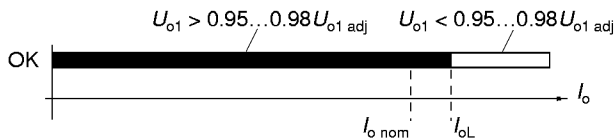
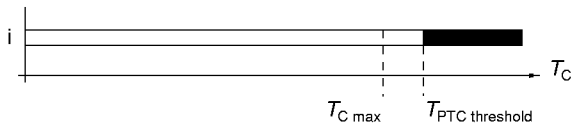


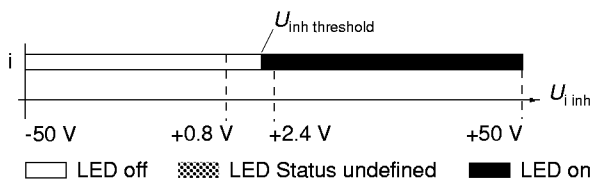
Fig. 11
LEDs "OK" and "i" status versus input voltage
Conditions: $I_o \leq I_o\ nom$, $T_C \leq T_C\ max$, $U_{inh} \leq 0.8\ V$
 $U_{i\ uv}$ = undervoltage lock-out, $U_{i\ ov}$ = overvoltage lock-out



LED "OK" status versus output current
Conditions: $U_{i\ min} \dots U_{i\ max}$, $T_C \leq T_C\ max$, $U_{inh} \leq 0.8\ V$



LED "i" versus case temperature
Conditions: $U_{i\ min} \dots U_{i\ max}$, $I_o \leq I_o\ nom$, $U_{inh} \leq 0.8\ V$



LED "i" versus U_{inh}
Conditions: $U_{i\ min} \dots U_{i\ max}$, $I_o \leq I_o\ nom$, $T_C \leq T_C\ max$

□ LED off ▤ LED Status undefined ■ LED on

Electromagnetic Compatibility (EMC)

A suppressor diode together with an input filter form an effective protection against input transient voltages which typically occur in most installations, but especially in battery

driven mobile applications. The H series has been successfully tested to the following specifications:

Electromagnetic Immunity

Table 8: Immunity type tests

| Phenomenon | Standard ¹ | Level | Coupling mode ² | Value applied | Waveform | Source imped. | Test procedure | In oper. | Per-form. ³ |
|-----------------------------------|-----------------------|-------|----------------------------|---------------------|---|---------------|---|----------|------------------------|
| Electrostatic discharge (to case) | IEC/EN 61000-4-2 | 2 | contact discharge | 4000 V _p | 1/50 ns | 330 Ω | 10 positive and 10 negative discharges | yes | A |
| Electromagnetic field | IEC/EN 61000-4-3 | x | antenna | 20 V/m | AM 80% 1 kHz | n.a. | 26...1000 MHz | yes | A |
| Electrical fast transient/burst | IEC/EN 61000-4-4 | 1 | direct, i/c, +i/-i | 500 V _p | bursts of 5/50 ns 2.5 / 5 kHz over 15 ms; burst period: 300 ms | 50 Ω | 1 min positive 1 min negative transients per coupling mode | yes | A |
| Surge | IEC/EN 61000-4-5 | 1 | i/c | 500 V _p | 1.2/50 μs | 12 Ω | 5 pos. and 5 neg. surges per | yes | A |
| | | | +i/-i | | | 2 Ω | | | |

¹ Related and previous standards are referenced in *Technical Information: Standards*.

² i = input, o = output, c = case.

³ A = Normal operation, no deviation from specifications, B = Normal operation, temporary deviation from specs possible.

Electromagnetic Emissions

Table 9: Emissions at $U_{I\text{ nom}}$ and $I_{o\text{ nom}}$

| Series | Standard | |
|--------|----------------------|----------------------|
| | $\leq 30\text{ MHz}$ | $\geq 30\text{ MHz}$ |
| 12H | <A | <B |
| 24H | <B | <B |
| 48H | <B | <B |

Mechanical Data

Dimensions in mm. Tolerances ±0.3 mm unless otherwise indicated.

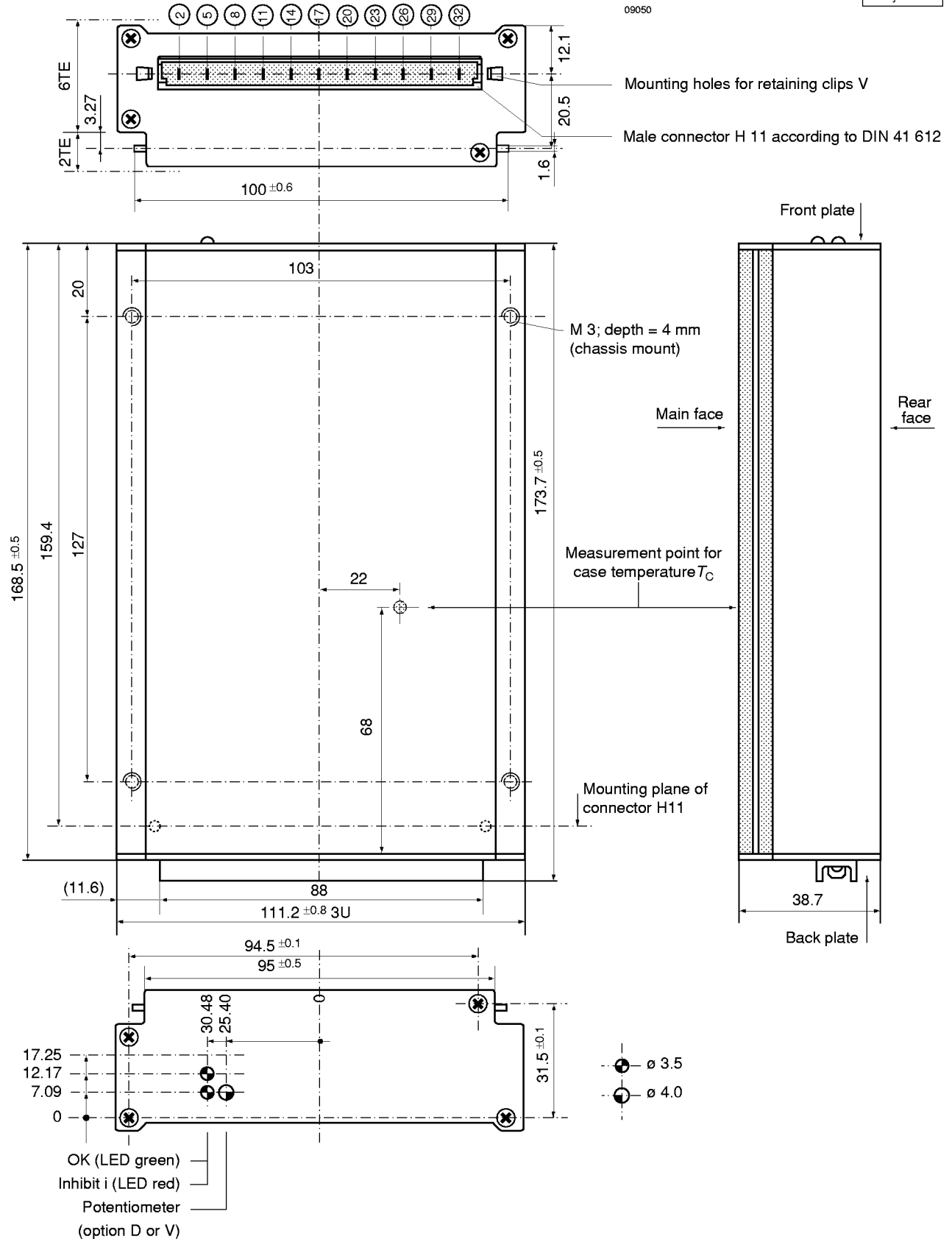


Fig. 12
DC-DC converter in case H02, weight 770 g (approx.)
Case aluminium, black finish and self cooling.

Immunity to Environmental Conditions

Table 10: Mechanical stress

| Test method | | Standard | Test conditions | Status |
|-------------|-------------------------|--|---|--------------------|
| Ca | Damp heat steady state | IEC/DIN IEC 60068-2-3 MIL-STD-810D section 507.2 | Temperature: 40 ±2 °C Relative humidity: 93 +2/-3 % Duration: 21 days | Unit not operating |
| Ea | Shock (half-sinusoidal) | IEC/EN/DIN EN 60068-2-27 MIL-STD-810D section 516.3 | Acceleration amplitude: 15 g _n = 147 m/s ² Bump duration: 11 ms Number of bumps: 18 (3 each direction) | Unit operating |
| Eb | Bump (half-sinusoidal) | IEC/EN/DIN EN 60068-2-29 MIL-STD-810D section 516.3 | Acceleration amplitude: 10 g _n = 98 m/s ² Bump duration: 16 ms Number of bumps: 6000 (1000 each direction) | |
| Fc | Vibration (sinusoidal) | IEC/EN/DIN EN 60068-2-6 MIL-STD-810D section 514.3 | Acceleration amplitude: 0.35 mm (10...60 Hz) 2 g _n = 20 m/s ² (60...2000 Hz) Frequency (1 Oct/min): 10...150 Hz Test duration: 3.75 h (1.25 h each axis) | |

Table 11: Temperature specifications, values given are for an air pressure of 800...1200 hPa (800...1200 mbar)

| Temperature | | Conditions | Standard -2 | | Option -7 | | Unit |
|-----------------|----------------------------------|--------------------------|-------------|-----|-----------|-----|------|
| Characteristics | | | min | max | min | max | |
| T _A | Ambient temperature ¹ | Operational ² | -10 | 50 | -25 | 71 | °C |
| T _C | Case temperature ³ | | -10 | 80 | -25 | 95 | |
| T _S | Storage temperature ¹ | Not operational | -25 | 100 | -40 | 100 | |

¹ MIL STD 810D section 501.2 and 502.2. ² See *Thermal considerations*. ³ Overtemperature lock-out at T_C >95°C (PTC).

Table 12: MTBF

| Values at specified Case Temperature | Module Types | Ground Benign 40°C | Unit |
|--------------------------------------|--------------|--------------------|------|
| MTBF ¹ | H1000 | 384'000 | h |
| | H2000 | 306'000 | |
| | H3000 | 270'000 | |

¹ Calculated in accordance with MIL-HDBK-217E (calculation according to edition F would show even better results)

Safety and Installation Instructions

Connector pin Allocation

The connector pin allocation table defines the electrical potentials and the physical pin positions on the H11 connector. Pin no. 26, the protective earth pin present on all 12H...48H DC-DC converters is leading, ensuring that it makes contact with the female connector first.

Table 13: H11 connector pin allocation and designation

| Electrical Determination | H1000 | | H2000 | | H3000 | |
|--|-------|-------|-------|-------|-------|-------|
| | Pin | Ident | Pin | Ident | Pin | Ident |
| Inhibit control input Safe Data or ACFAIL | 2 | i | 2 | i | 2 | i |
| Output voltage (positive) Output voltage (negative) | 8 | Vo1+ | 8 | Vo1+ | 8 | Vo3+ |
| | 11 | Vo1- | 11 | Vo1- | 11 | Vo3- |
| Control input + Control input - | 14 | R | | | | |
| | 17 | G | | | | |
| Output voltage (positive) Output voltage (negative) | | | 14 | Vo2+ | 14 | Vo2+ |
| | | | 17 | Vo2- | 17 | Vo2- |
| Output voltage (positive) Output voltage (negative) | 20 | Vo1+ | 20 | Vo1+ | 20 | Vo1+ |
| | 23 | Vo1- | 23 | Vo1- | 23 | Vo1- |
| Protective earthing ¹ | 26 | ⊕ | 26 | ⊕ | 26 | ⊕ |
| DC input voltage | 29 | Vi+ | 29 | Vi+ | 29 | Vi+ |
| DC input voltage | 32 | Vi- | 32 | Vi- | 32 | Vi- |

¹ Leading pin (pregrounding)

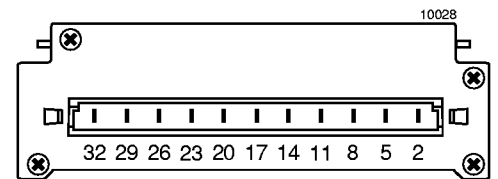


Fig. 13
View of male H11 connector.

Installation Instructions

The H-family DC-DC converters are components, intended exclusively for inclusion within other equipment by an industrial assembly operation or by professional installers. 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. See also *Technical Information: Installation and Application*.

Connection to the system shall be made via the female connector H11 (see *Accessories*). Other installation methods may not meet the safety requirements.

All DC-DC converters are provided with pin no. 26 (⊕), which is reliably connected with their case. For safety reasons it is essential to connect this pin with the protective earth of the supply system if required in *Safety of operator accessible output circuit*.

Ensure that a unit failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also *Safety of operator accessible output circuit*.

To prevent excessive current flowing into the unit (e.g. by an internal short-circuit), an external fuse suitable for the application and in compliance with the local requirements should be installed in the wiring to one or both input pins (no. 29 and/or no. 32). See also *Input Fuse*.

Important: Whenever the inhibit function is not in use, pin no. 2 (I) should be connected to pin no. 23 (Vo1-) to enable the output(s).

Do not open the modules, or guarantee will be invalidated.

Isolation

The electric strength test is performed as a factory test in accordance with IEC/EN 60950 and UL 1950 and should not be repeated in the field. Melcher will not honour any guarantee/warranty claims resulting from electric strength field tests.

Table 14: Isolation

| Characteristic | | Input to case | Input to output | Output to case | Output to output | Unit |
|-----------------------------------|---|---------------|------------------|----------------|-------------------|-------------------|
| Electric strength test voltage | Required according to IEC/EN 60950 | 1.5 | 3.0 ¹ | 0.5 | - | kV _{rms} |
| | | 2.1 | 4.2 ¹ | 0.7 | - | kV DC |
| | Actual factory test 1 s | 2.8 | 5.6 ¹ | 1.4 | 0.3 | |
| | AC test voltage equivalent to actual factory test | 2.0 | 4.0 ¹ | 1.0 | 0.2 | kV _{rms} |
| Insulation resistance at 500 V DC | | >300 | >300 | >300 | >100 ² | MΩ |

¹ In accordance with IEC/EN 60950 only subassemblies are tested in factory with this voltage.

² Tested at 300 V DC.

For creepage distances and clearances refer to *Technical Information: Safety*.

Make sure that there is sufficient air flow possible for convection cooling. This should be verified by measuring the case temperature when the unit is installed and operated in the end-use application. The maximum specified case temperature $T_{C\text{ max}}$ shall not be exceeded. See also *Thermal Considerations*.

Cleaning Agents

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

Standards and approvals

12H...48H DC-DC converters correspond to class I equipment. All types are UL recognized according to UL 1950, UL recognized for Canada to CAN/CSA C22.2 No. 950-95 and LGA approved to IEC/EN 60950 standards.

The units have been evaluated for:

- Building in
- Supplementary insulation between input and case and double or reinforced insulation between input and output, based on 250 V AC and 400 V DC
- Operational insulation between output(s) and case
- Operational insulation between the outputs
- The use in a pollution degree 2 environment
- Connecting the input to a primary or secondary circuit with a maximum transient rating of 2500 V.

The DC-DC converters are subject to manufacturing surveillance in accordance with the above mentioned UL, CSA, EN and with ISO 9001 standards.

Protection Degree

Condition: Female connector fitted to the unit.

IP 40: All units, except those with option D or V with potentiometer.

IP 20: All units fitted with option D or V with potentiometer.

Safety of operator accessible output circuit

If the output circuit of a DC-DC converter is operator accessible, it shall be an SELV circuit according to the IEC/EN 60950 related safety standards.

Since the H-family DC-DC converters provide double or reinforced insulation between input and output, based on a rated primary input voltage of 250 V AC and 400 V DC only operational insulation is needed between the AC mains and the input of the DC-DC converter. This means that there is no need for an electrical isolation between the AC mains circuit and the DC-DC converter input circuit to cause the output of an H-family DC-DC converter to be an SELV circuit.

Only voltage adaption and rectification to the specified input voltage range of the DC-DC converter is needed.

The following table shows some possible installation configurations, compliance with which causes the output circuit of the DC-DC converter to be an SELV circuit according to IEC/EN 60950 up to a configured output voltage (sum of nominal voltages if in series or +/- configuration) of 36 V.

However, it is the sole responsibility of the installer to assure the compliance with the relevant and applicable safety regulations. More information is given in *Technical Information: Safety*.

Table 15: Safety concept leading to an SELV output circuit

| Conditions | Front end | | | DC-DC converter | Result |
|------------------------|---|---|--|---|---|
| Nominal supply voltage | Minimum required grade of isolation, to be provided by the AC-DC front end, including mains supplied battery charger | Nominal DC 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 | Safety status of the DC-DC converter output circuit |
| Mains ≤250 V AC | Operational (i.e. there is no need for electrical isolation between the mains supply voltage and the DC-DC converter input voltage) | ≤400 V ¹ (The rated voltage between any input pin and earth can be up to 250 V AC or 400 V DC) | Primary circuit | Double or reinforced insulation, based on 250 V AC and 400 V DC (provided by the DC-DC converter) and earthed case ² | SELV circuit |
| | | ≤400 V | Unearthed hazardous voltage secondary circuit | Supplementary insulation, based on 250 V AC and 400 V DC and double or reinforced insulation, based on the maximum nominal output voltage from the front end (both provided by the DC-DC converter) and earthed case ³ | |

¹ The front end output voltage should match the specified operating input voltage range of the DC-DC converter.
² The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC/EN 60950.
³ The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC/EN 60950. If the converter case shall not be connected with earth, the front end output circuit has to be insulated from earth according to the relevant safety standard by at least basic insulation, based on the maximum nominal output voltage from the front end, and insulated from the converter case by at least supplementary insulation, based on the maximum nominal mains voltage. The converter case is then considered to be a double insulated accessible part

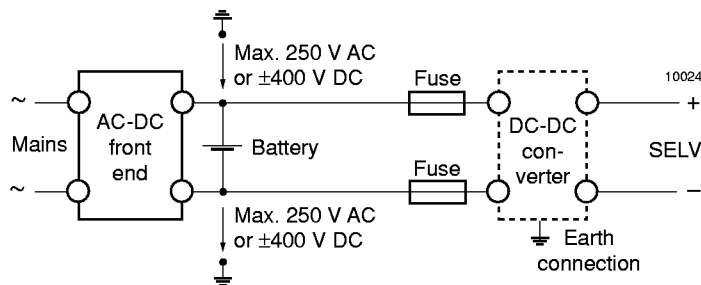


Fig. 14 Schematic safety concept. Use earth connection as per table *Safety concept leading to an SELV output circuit*. Use fuse according to *Installation Instructions*.

Description of Options

Table 16: Survey of options

| Option | Function of Option | Characteristic |
|------------------|---|---|
| -7 | Extended operational ambient temperature range | $T_A = -25...71^\circ\text{C}$ |
| D ¹ | Input and/or output undervoltage monitoring circuitry | Safe data signal output (D1...D8) |
| V ^{1,2} | Input and output undervoltage monitoring circuitry | ACFAIL signal according to VME specifications (V2, V3) |

¹ Option D excludes option V and vice versa

² Only available with main output voltage $U_{o1} = 5.1\text{ V}$

-7 Extended Temperature Range

Option -7 extends the operational ambient temperature range from $-10...50^\circ\text{C}$ (standard) to $-25...71^\circ\text{C}$. The power supplies provide full nominal output power with convection cooling.

D Undervoltage Monitor

The input and/or output undervoltage monitoring circuit operates independently of the built-in input undervoltage lock-out circuit. A logic "low" (JFET output) or "high" signal (NPN output) is generated at pin 5 as soon as one of the monitored voltages drops below the preselected threshold level

U_t . The return for this signal is Vo1- (pin 23). The D output recovers when the monitored voltage(s) exceed(s) $U_t + U_h$. The threshold level U_t is adjustable by a potentiometer, accessible through a hole in the front cover.

Option D exists in various versions D1...D8 as shown in the following table.

Table 17: Undervoltage monitor functions

| Output type | | Monitoring | | Minimum adjustment range of threshold level U_t | | Typical hysteresis U_h [% of U_t] for $U_{t\text{ min}}...U_{t\text{ max}}$ | |
|-------------|-----|------------|----------|---|--------------------------------|--|-----------|
| JFET | NPN | U_i | U_{o1} | U_{ti} | U_{to} | U_{hi} | U_{ho} |
| D1 | D5 | no | yes | - | $3.5\text{ V}...48\text{ V}^1$ | - | $2.3...1$ |
| D2 | D6 | yes | no | $U_{i\text{ min}}...U_{i\text{ max}}^1$ | - | $3.0...0.5$ | - |
| D3 | D7 | yes | yes | $U_{i\text{ min}}...U_{i\text{ max}}^1$ | $0.95...0.98\ U_{o1}^2$ | $3.0...0.5$ | "0" |
| D4 | D8 | no | yes | - | $0.95...0.98\ U_{o1}^2$ | - | "0" |

¹ Threshold level adjustable by potentiometer (not recommended for mobile applications)

² Fixed value between 95% and 98% of U_{o1} (tracking)

JFET output (D1...D4):

Connector pin D is internally connected via the drain-source path of a JFET (self-conducting type) to the negative potential of output 1. $U_D \leq 0.4\text{ V}$ (logic low) corresponds to a monitored voltage level (U_i and/or U_{o1}) $< U_t$. The current I_D through the JFET should not exceed 2.5 mA. The JFET is protected by a 0.5 W Zener diode of 8.2 V against external overvoltages.

| U_i, U_{o1} status | D output, U_D |
|--------------------------------|--|
| U_i or $U_{o1} < U_t$ | low, L, $U_D \leq 0.4\text{ V}$ at $I_D = 2.5\text{ mA}$ |
| U_i and $U_{o1} > U_t + U_h$ | high, H, $I_D \leq 25\ \mu\text{A}$ at $U_D = 5.25\text{ V}$ |

NPN output (D5...D8):

Connector pin D is internally connected via the collector-emitter path of a NPN transistor to the negative potential of output 1. $U_D \leq 0.4\text{ V}$ (logic low) corresponds to a monitored voltage level (U_i and/or U_{o1}) $> U_t + U_h$. The current I_D through the open collector should not exceed 20 mA. The NPN output is not protected against external overvoltages. U_D should not exceed 40 V.

| U_i, U_{o1} status | D output, U_D |
|--------------------------------|--|
| U_i or $U_{o1} < U_t$ | high, H, $I_D \leq 25\ \mu\text{A}$ at $U_D = 40\text{ V}$ |
| U_i and $U_{o1} > U_t + U_h$ | low, L, $U_D \leq 0.4\text{ V}$ at $I_D = 20\text{ mA}$ |

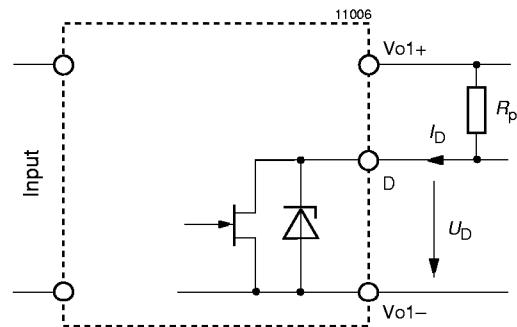


Fig. 15
Options D1...D4, JFET output

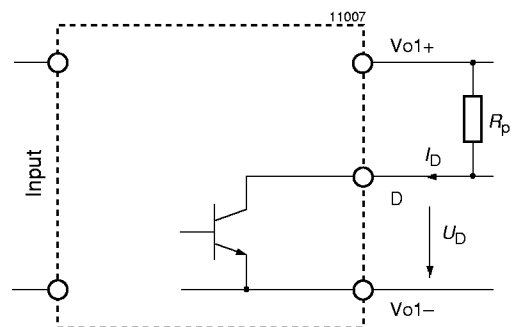


Fig. 16
Options D5...D8, NPN output

Threshold tolerances and hysteresis:

If U_i is monitored, the internal input voltage after the input filter is measured. Consequently this voltage differs from the voltage at the connector pins by the voltage drop ΔU_{ti} across the input filter. The value of ΔU_{ti} depends upon the input voltage range, threshold level U_t , temperature and input current. The input current is a function of the input voltage and the output power.

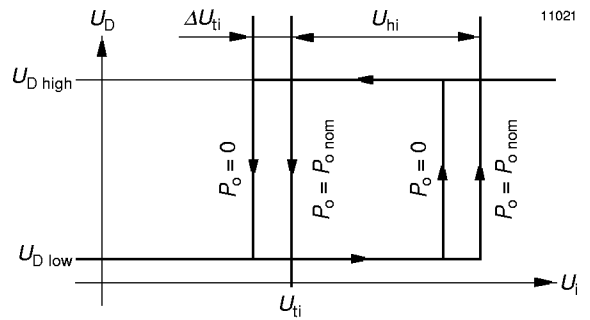
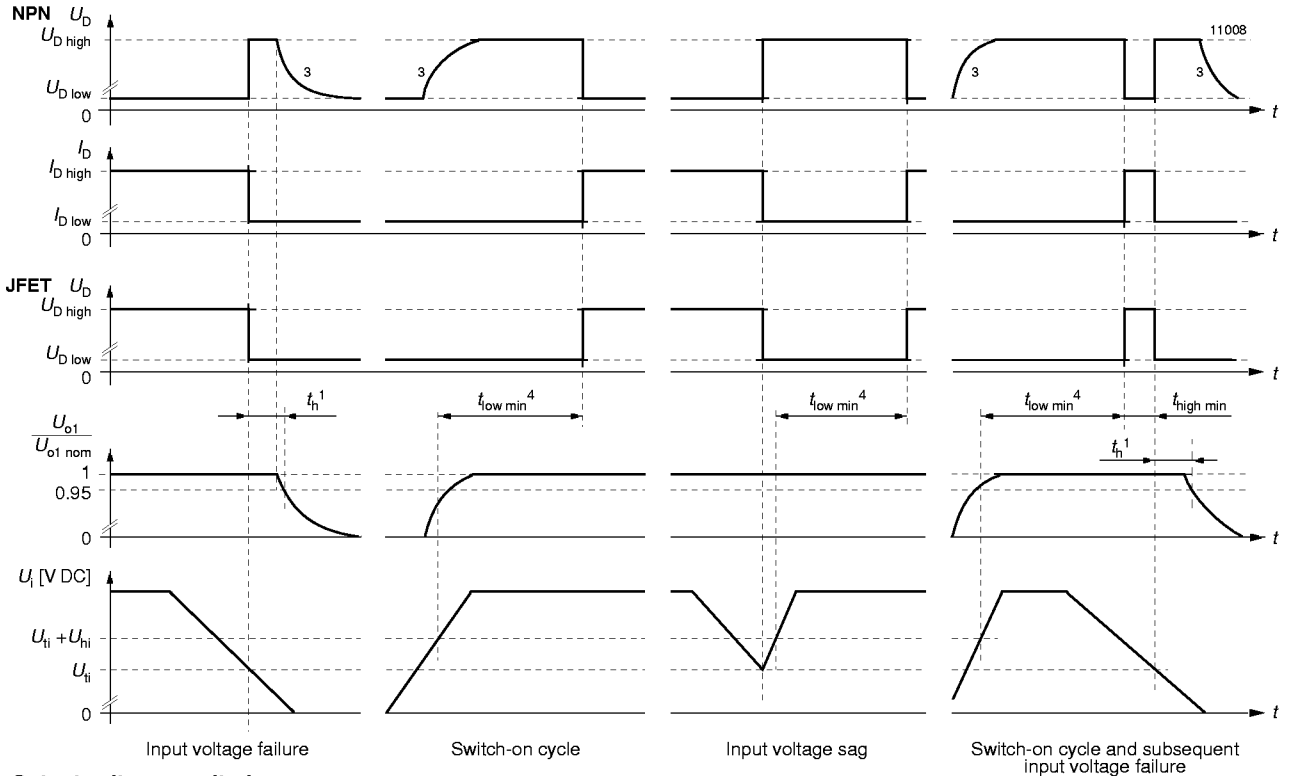
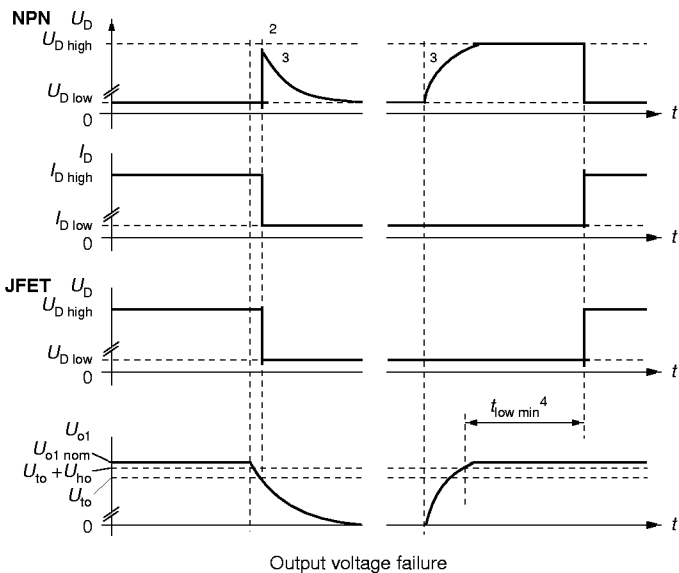


Fig. 17
Definition of U_{ti} , ΔU_{ti} and U_{hi} (JFET output)

Input voltage monitoring



Output voltage monitoring



- ¹ n.a.
- ² With output voltage monitoring the hold-up time $t_h = 0$
- ³ The D signal remains high if the D output is connected to an external source.
- ⁴ $t_{low\ min} = 40...200\ ms$, typically 80 ms

Fig. 18
Relationship between U_i , U_{o1} , U_D , I_D and $U_{o1}/U_{o,nom}$ versus time.

V ACFAIL signal (VME)

Available for units with $U_{o1} = 5.1$ V.

This option defines an undervoltage monitoring circuit for the input or the input and main output voltage equivalent to option D and generates the ACFAIL signal (V signal) which conforms to the VME standard. The low state level of the ACFAIL signal is specified at a sink current of $I_V = 48$ mA to $U_V \leq 0.6$ V (open-collector output of a NPN transistor). The pull-up resistor feeding the open-collector output should be placed on the VME backplane.

After the ACFAIL signal has gone low, the VME standard requires a hold-up time t_h of at least 4 ms before the 5.1 V output drops to 4.875 V when the 5.1 V output is fully loaded. This hold-up time t_h should be provided by an external input capacitance. Consequently the working input voltage and the threshold level U_{ti} should be adequately above the minimum input voltage $U_{i\ min}$ of the converter so that enough energy is remaining in this capacitance.

If the input voltage is below the required level, an external hold-up capacitor ($C_{i\ ext}$) should be added.

Table 18: Available internal input capacitance and factory potentiometer setting of U_{ti} with resulting hold-up time.

| Types | 12H | 24H | 48H | Unit |
|--------------|------|------|------|------|
| $C_{i\ min}$ | 2.2 | 0.75 | 0.19 | mF |
| U_{ti} | 9.5 | 19.5 | 39 | V DC |
| t_h | 0.19 | 0.87 | 0.89 | ms |

Option V operates independently of the built-in input undervoltage lock-out circuit. A logic "low" signal is generated at pin 5 as soon as one of the monitored voltages drops below the preselected threshold level U_t . The return for this signal is Vo1– (pin 23). The V output recovers when the monitored

Table 19: Undervoltage monitor functions

| V output (VME compatible) | Monitoring | | Minimum adjustment range of threshold level U_t | | Typical hysteresis U_h [% of U_t] for $U_{t\ min} \dots U_{t\ max}$ | |
|---------------------------|------------|----------|---|----------------------------|--|----------|
| | U_i | U_{o1} | U_{ti} | U_{to} | U_{hi} | U_{ho} |
| V2 | yes | no | $U_{i\ min} \dots U_{i\ max}^1$ | - | 3.0...0.5 | - |
| V3 | yes | yes | $U_{i\ min} \dots U_{i\ max}^1$ | $0.95 \dots 0.98 U_{o1}^2$ | 3.0...0.5 | "0" |

¹ Threshold level adjustable by potentiometer (not recommended for mobile applications)

² Fixed value between 95% and 98% of U_{o1} (tracking), output undervoltage monitoring is not a requirement of VME standard

V output (V2, V3):

Connector pin V is internally connected to the open collector of a NPN transistor. The emitter is connected to the negative potential of output 1. $U_V \leq 0.6$ V (logic low) corresponds to a monitored voltage level (U_i and/or U_{o1}) $< U_t$. The current I_V through the open collector should not exceed 50 mA. The NPN output is not protected against external overvoltages. U_V should not exceed 80 V.

| U_i, U_{o1} status | V output, U_V |
|--------------------------------|---|
| U_i or $U_{o1} < U_t$ | low, L, $U_V \leq 0.6$ V at $I_V = 50$ mA |
| U_i and $U_{o1} > U_t + U_h$ | high, H, $I_V \leq 25$ μ A at $U_V = 5.1$ V |

Formula for threshold level for desired value of t_h :

$$U_{ti} = \sqrt{\frac{2 \cdot P_o \cdot (t_h + 0.3 \text{ ms}) \cdot 100}{C_{i\ min} \cdot \eta}} + U_{i\ min}^2$$

Formula for additional external input capacitor

$$C_{i\ ext} = \frac{2 \cdot P_o \cdot (t_h + 0.3 \text{ ms}) \cdot 100}{\eta \cdot (U_{ti}^2 - U_{i\ min}^2)} - C_{i\ min}$$

where as:

$C_{i\ min}$ = minimum internal capacitance [mF], according to the table below

$C_{i\ ext}$ = external input capacitance [mF]

P_o = output power [W]

η = efficiency [%]

t_h = hold-up time [ms]

$U_{i\ min}$ = minimum input voltage [V]

U_{ti} = threshold level [V]

Remarks: The threshold level U_{ti} of option V2 and V3 is adjusted during manufacture to a value according to table *Undervoltage monitor functions, section Option D*.

A decoupling diode should be connected in series with the input to avoid the input capacitance discharging through other loads connected to the same source voltage.

voltage(s) exceed(s) $U_t + U_h$. The threshold level U_t is adjustable by a potentiometer accessible through a hole in the front cover.

Versions V2 and V3 are available as shown below.

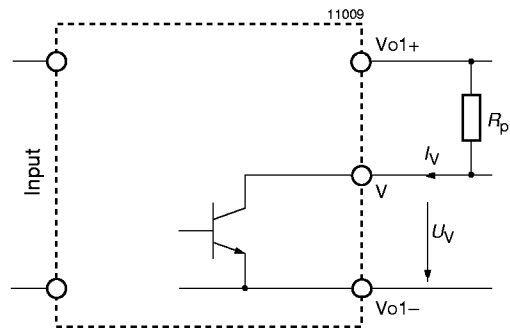


Fig. 19 Output configuration of options V2 and V3

Threshold tolerances and hysteresis:

If U_i is monitored, the internal input voltage is measured after the input filter. Consequently this voltage differs from the voltage at the connector pins by the voltage drop ΔU_{ti} across input filter and rectifier. The value of ΔU_{ti} depends upon the input voltage range, threshold level U_t , temperature and input current. The input current is a function of input voltage and output power.

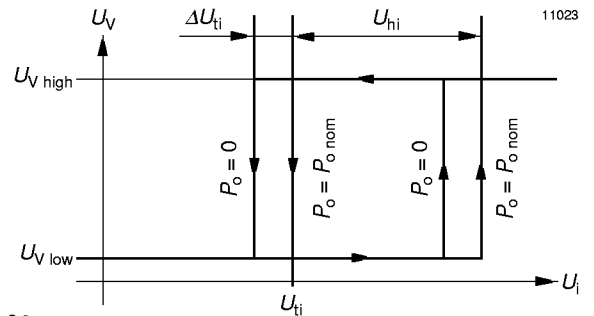
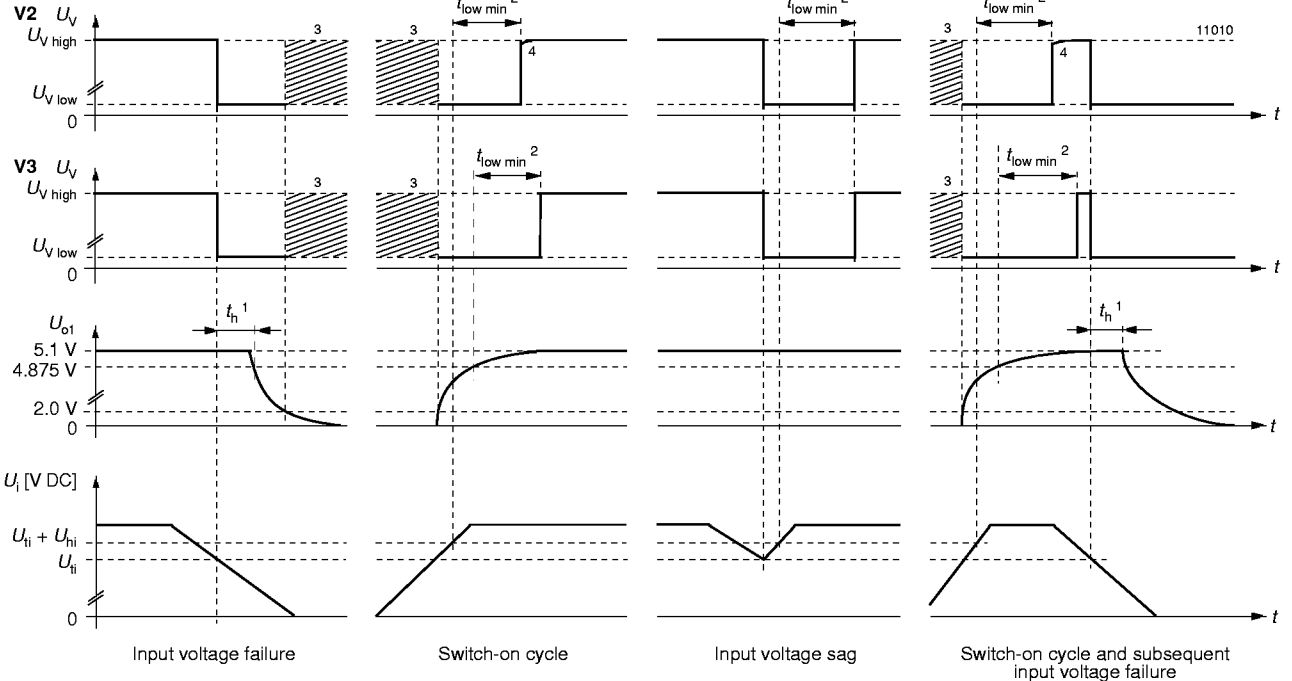
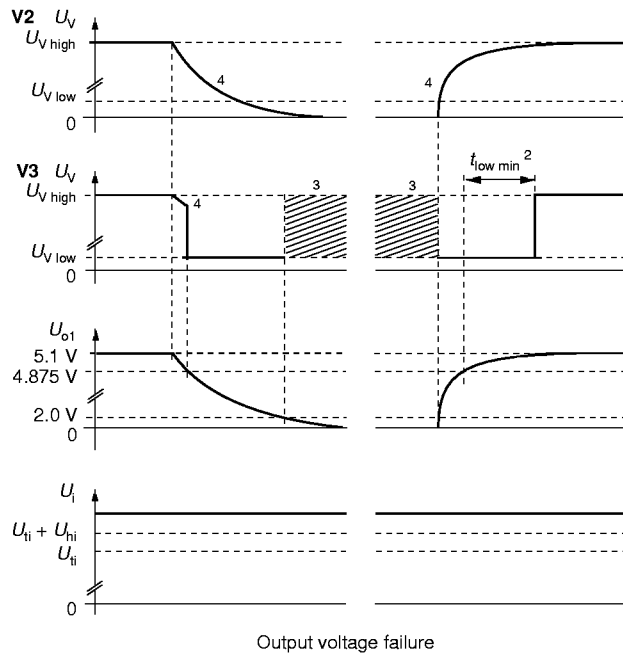


Fig. 20
Definition of U_{ti} , ΔU_{ti} and U_{hi}

Input voltage monitoring



Output voltage monitoring



- 1 VME request: minimum 4 ms
- 2 $t_{low\ min} = 40 \dots 200$ ms, typically 80 ms
- 3 U_V level not defined at $U_{o1} < 2.0$ V
- 4 The V signal drops simultaneously with the output voltage, if the pull-up resistor R_P is connected to $Vo1+$. The V signal remains high if R_P is connected to an external source.

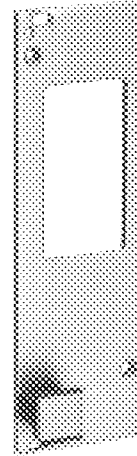
Fig. 21
Relationship between U_i , U_{o1} , U_V , I_V and $U_{o1}/U_{o\ nom}$ versus time.

Accessories

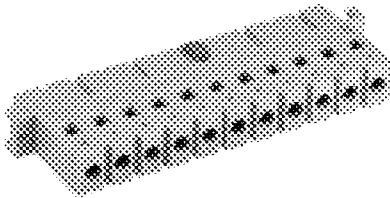
A variety of electrical and mechanical accessories are available including:

- Front panels for 19" rack mounting, Schroff and Intermas systems.
- Mating H11 connectors with screw, solder, fast-on or press-fit terminals.
- Connector retention facilities.
- Code key system for connector coding.
- Flexible H11 PCB for mounting of the unit onto a PCB.
- Chassis mounting plates for mounting the 19" cassette to a chassis/wall where only frontal access is given.
- Universal mounting bracket for DIN-rail or chassis mounting.

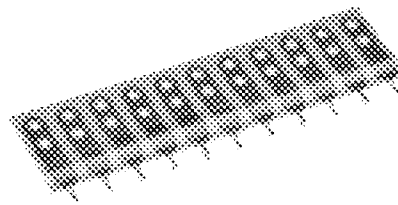
For more detailed information please refer to *Accessory Products*.



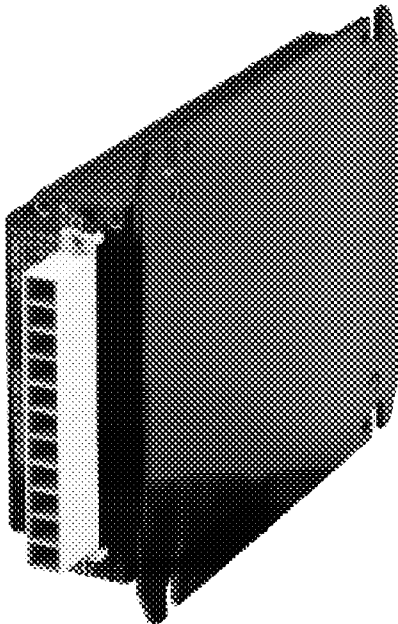
Front panels



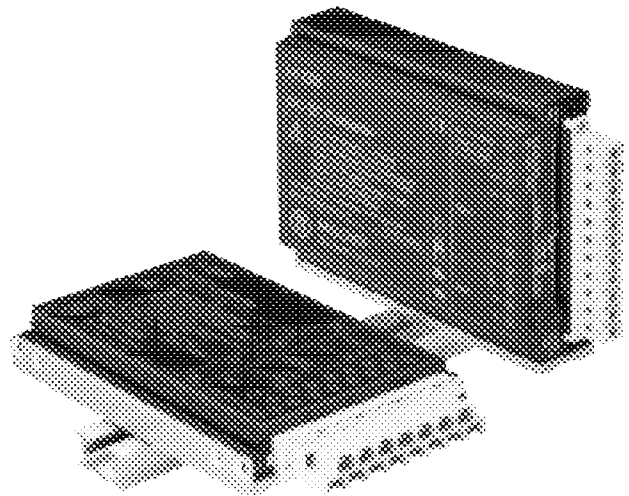
H11 female connector,
Code key system



Flexible H11 PCB



Mounting plate,
Connector retention clips



Universal mounting bracket for DIN-rail mounting.