# NSR: Negative Switching Regulators

**NSR-Family**

Case A01


**No input to output isolation**
**Single output of –5 to –36 V DC/15...72 W**
**Input voltage up to –80 V DC**

- High efficiency up to 94%
- Wide input voltage range
- Low input-to-ouptut differential voltage
- Very good dynamic properties
- Input undervoltage cut-out
- Continuous no-load and short-circuit proof
- Parallel configurations possible
- No derating

Safety according to IEC 950



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## Type Survey

*Table 1: Type survey*

| Nominal output voltage $U_{o\ nom}$ | Nominal output current $I_{o\ nom}$ | Input voltage range $U_i$ [1] | Nominal input voltage $U_{i\ nom}$ | Efficiency $\eta$ | Type designation | Options |
|---|---|---|---|---|---|---|
| –5 V | 4 A [2] | –7...–40 V | –20 V | 82% | NSR 54-7 | -9, i, P, R, Y |
| | 3 A | –8...–80 V | –40 V | 77% | NSR 53-7 | |
| –12 V | 2.5 A | –15...–80 V | | 86% | NSR 122.5-7 | |
| –15 V | | –19...–80 V | | 88% | NSR 152.5-7 | |
| –24 V | 2 A | –29...–80 V | –50 V | 91% | NSR 242-7 | |
| –36 V | | –42...–80 V | –60 V | 94% | NSR 362-7 | |

[1] See also data $\Delta U_{io\ min}$ (min. differential voltage $U_i – U_o$).
[2] Regulator with –5 V, 5 A (NSA 55) available on request. Ask for data.

## Description

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

**External input circuitry**

An external input filter FN 38 or FN 80 (see "Accessories") or an external capacitor (see "Application Notes") is required in rectifier mode and in DC operation mode only, if the sum of the lengths of the two input lines between source and input is greater than approx. 0.3 m (0.5 m twisted). For long connection lines the use of the external filter is recommended in order to reduce superimposed interference voltages or currents and to prevent oscillation.

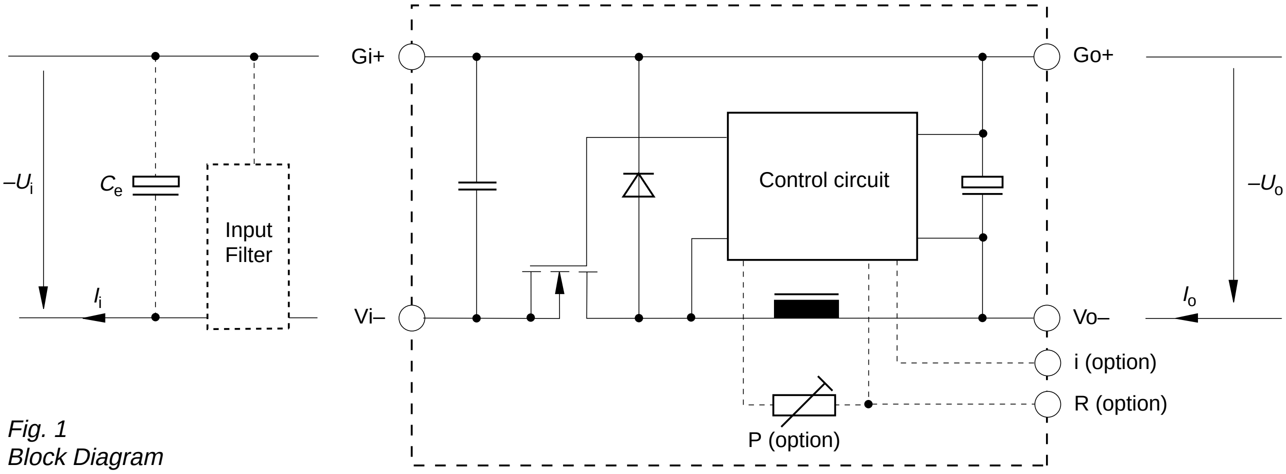



*Fig. 1*
*Block Diagram*



## Safety and Installation Instructions

### Safety

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

In the following section an interpretation is provided of the IEC 950 safety standard with respect to the safety status of the output circuit. However, it is the sole responsibility of the installer or user to assure the compliance with the relevant and applicable safety standards.

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

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

*Table 2: Insulation concept for SELV circuits*

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

[1] The installer shall provide an approved fuse (slow blow type with lowest rating suitable for the application, max. 12.5 A) in the positive or negative input conductor directly at the input of the switching regulator. For UL's purpose, the fuse needs to be UL-listed.
[2] Has to be insulated from earth by double or reinforced insulation according to the relevant safety standard, based on the maximum input voltage of the switching regulator.
[3] The earth connection has to be provided by the installer according to the relevant safety standards, e.g. IEC 950.

### Standards and Approvals

All Melcher power supplies are subject to manufacturing surveillance in accordance with ISO 9001 standards.

All units are UL recognized as per UL 1950, UL 1012 and CAN/CSA C22.2 No. 234-M90.

### Cleaning Agents

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

### Protection Degree

The protection degree is defined by IP 40. With option P this reduces to IP 20.

## Immunity to Environmental Conditions

*Table 3: Mechanical stress*

| Test Method | | Standard | Test Conditions | | Status |
|---|---|---|---|---|---|
| Ca | Damp heat<br>steady state | DIN 40046 part<br>IEC 68-2-3<br>MIL-STD-810D section 507.2 | Temperature:<br>Relative humidity:<br>Duration: | $40^{\pm 2}$ °C<br>$93^{+2/-3}$ %<br>56 days | Unit not operating |
| Ea | Shock<br>(half-sinusoidal) | DIN 40046 part 7<br>IEC 68-2-27<br>MIL-STD-810D section 516.3 | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 100 $g_n$ = 981 $m/s^2$<br>6 ms<br>18 (3 each direction) | Unit operating |
| Eb | Continuous shock<br>(half-sinusoidal) | DIN 40046 part 26<br>IEC 68-2-29<br>MIL-STD-810D section 516.3 | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 40 $g_n$ = 392 $m/s^2$<br>6 ms<br>6000 (1000 each direction) | Unit operating |
| Fc | Vibration<br>(sinusoidal) | DIN 40046 part 8<br>IEC 68-2-6<br>MIL-STD-810D section 514.3 | Frequency (1 Oct/min):<br>Max. vibration amplitude:<br>Acceleration amplitude:<br>Test duration: | 10...2000 Hz<br>0.7 mm (10...60 Hz)<br>10 $g_n$ = 98 $m/s^2$ (60...2000 Hz)<br>7.5 h (2.5 h each axis) | Unit operating |
| Fda | Random vibration<br>wide band<br>reproducibility high | DIN 40046 part 23<br>IEC 68-2-35 | Acceleration spectral density:<br>Frequency band:<br>Acceleration magnitude:<br>Test duration: | 0.05 $g^2$/Hz<br>20...500 Hz<br>4.9 $g_{rms}$<br>3 h (1 h each axis) | Unit not operating |
| Kb | Salt mist<br>cyclic<br>(sodium chloride<br>NaCl solution) | DIN 40046 part 105<br>IEC 68-2-52 | Concentration:<br>Duration:<br>Storage:<br>Storage duration:<br>Number of cycles: | 5% (30°C)<br>2 h per cycle<br>40°C, 93% rel. humidity<br>22 h per cycle<br>3 | Unit not operating |

*Table 4: Temperature specifications, valid for air pressure of 800...1200 hPa (800...1200 mbar)*

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

[1] MIL-STD-810D section 501.2 and 502.2

*Table 5: MTBF and device hours*

| MTBF | Ground Fixed | | Ground Mobile | | Device Hours [1] |
|---|---|---|---|---|---|
| MTBF acc. to MIL-HDBK-217D | $T_C$ = 40°C | $T_C$ = 70°C | $T_C$ = 40°C | $T_C$ = 70°C | |
| | 160'000 h | 70'000 h | 45'000 h | 22'000 h | 1'300'000 h |

[1] Statistical values, based on an average of 4300 working hours per year and in general field use

# Electromagnetic Compatibility EMC

### Immunity

General condition: Case not earthed.

*Table 6: Immunity type tests*

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

[1] Normal operation, no deviation from specifications
[2] Normal operation, temporary deviation from specs possible
[3] External input filter FN 38 or FN 80 necessary (see "Accessories")
[4] i = input, o = output, c = case
[5] In correspondance with DIN 57435 part 303 and VDE 0435 part 303 (1984-09)
[6] Open circuit

### Emission

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

# Electrical Input and Output Data

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

*Table 7a: Input and output data*

| Characteristics | | Conditions | NSR 54 | | | NSR 53 | | | NSR 122.5 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | min | typ | max | min | typ | max | min | typ | max | |
| **Output** | | | | | | | | | | | | |
| $U_o$ | Output voltage | $U_{i\,nom}$, $I_{o\,nom}$ | –4.97 | | –5.03 | –4.97 | | –5.03 | –11.92 | | –12.07 | V |
| $I_{o\,nom}$ | Output current | $U_{i\,min}...U_{i\,max}$<br>$T_{C\,min}...T_{C\,max}$ | | 4.0 | | | 3.0 | | | 2.5 | | A |
| $I_{oL}$ | Output current limitation response | | 4.0 | | 5.2 | 3.0 | | 3.9 | 2.5 | | 3.25 | |
| $u_o$ | Ripple at output (BW = 20 MHz) | $U_{i\,nom}$<br>$I_{o\,nom}$ | | 25 | 45 | | 35 | 65 | | 50<br>60 | 75<br>90[1] | $mV_{pp}$ |
| $\Delta U_{o\,U}$ | Static control deviation versus input voltage $U_i$ | $U_{i\,min}...U_{i\,max}$<br>$I_{o\,nom}$ | | 30 | 45 | | 30 | 45 | | 50<br>60 | 75<br>90[1] | mV |
| $\Delta U_{o\,I}$ | Static control deviation versus output current $I_o$ | $U_{i\,nom}$<br>$I_o = 0...I_{o\,nom}$ | | 20 | 25 | | 20 | 25 | | 35<br>40 | 45<br>50[1] | |
| $u_{o\,d}$ | Dynamic control deviation[2] | $U_{i\,nom}$<br>$I_{o\,nom} \leftrightarrow {}^1/_3\, I_{o\,nom}$ | | 200 | | | 100 | | | 180 | | |
| $t_r$ | Dynamic load transient time recovery[2] | | | 40 | | | 50 | | | 60 | | µs |
| $\alpha_{uo}$ | Temperature coefficient $\Delta U_o/\Delta T_C$ | $U_{i\,min}...U_{i\,max}$<br>$T_{C\,min}...T_{C\,max}$<br>$I_o = 0...I_{o\,nom}$ | | | ±1 | | | ±1 | | | ±2 | mV/K |
| | | | | | ±0.02 | | | ±0.02 | | | ±0.02 | %/K |
| **Input** | | | | | | | | | | | | |
| $U_i$ | Input voltage | $I_o = 0...I_{o\,nom}$<br>$T_{C\,min}...T_{C\,max}$ | –7 | | –40 | –8 | | –80 | –15 | | –80 | V DC |
| $\Delta U_{io\,min}$ | Minimum differential voltage $U_i$ - $U_o$[3] | | | –2 | | | –3 | | | –3 | | V |
| $U_{i\,o}$ | Undervoltage cut-out | | | –6.3 | | | –7.3 | | | –7.3 | | |
| $I_{i\,0}$ | No load input current | $I_o = 0$<br>$U_{i\,min}...U_{i\,max}$ | | | 45 | | | 40 | | | 35 | mA |
| $I_{i\,m}$ | Peak value of inrush current[4] | $U_{i\,nom}$ | | 75 | | | 150 | | | 150 | | A |
| $t_{i\,s}$ | Rise time[4] | | | 2.5 | | | 2.5 | | | 2.5 | | µs |
| $t_{i\,r}$ | Tail half value time[4] | | | 15 | | | 15 | | | 15 | | |
| $u_{i\,rfi}$ | RFI level at input, 0.01...30 MHz | VDE 0871 (6.78)<br>$U_{i\,nom}$, $I_{o\,nom}$ | | | A[6] | | | A[5] | | | A[5] | dB (µV) |
| **Efficiency** | | | | | | | | | | | | |
| $\eta$ | Efficiency | $U_{i\,nom}$, $I_{o\,nom}$ | | 82 | | | 77 | | | 86 | | % |
| **Isolation** | | | | | | | | | | | | |
| $U_{is}$ | Isolation test voltage electronics to case | Inputs/outputs interconnected | | 500 | | | 500 | | | 500 | | V DC |

[1] Lower row represents option -9 data only
[2] See "Dynamic Characteristics"
[3] The minimum differential voltage $\Delta U_{io\,min}$ between input and output increases linearly from 0 to 1 V at $T_A$ = 46°C and 71°C ($T_C$ = 70°C and 95°C)
[4] Definitions according to VDE 0433, part 3
[5] With FN 80 and $C_e$ = 470 µF (see "Accessories")
[6] With FN 38 and $C_e$ = 470 µF (see "Accessories")

*Table 7b: Input and output data*

| Characteristics | | Conditions | NSR 152.5 min | typ | max | NSR 242 min | typ | max | NSR 362 min | typ | max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Output** | | | | | | | | | | | | |
| $U_o$ | Output voltage | $U_{i\,nom}$, $I_{o\,nom}$ | –14.91 | | –15.09 | –23.85 | | –24.14 | –35.78 | | –36.22 | V |
| $I_{o\,nom}$ | Output current | $U_{i\,min}...U_{i\,max}$<br>$T_{C\,min}...T_{C\,max}$ | | 2.5 | | | 2.0 | | | 2.0 | | A |
| $I_{oL}$ | Output current limitation response | | 2.5 | | 3.25 | 2.0 | | 2.6 | 2.0 | | 2.6 | |
| $u_o$ [1] | Ripple at output (BW = 20 MHz) | $U_{i\,nom}$<br>$I_{o\,nom}$ | | 70<br>140 | 110<br>220 | | 100<br>125 | 175<br>220 | | 150<br>160 | 250<br>270 | mV$_{pp}$ |
| $\Delta U_{o\,U}$ [1] | Static control deviation versus input voltage $U_i$ | $U_{i\,min}...U_{i\,max}$<br>$I_{o\,nom}$ | | 70<br>150 | 100<br>220 | | 150<br>180 | 220<br>270 | | 200<br>275 | 270<br>370 | mV |
| $\Delta U_{o\,I}$ [1] | Static control deviation versus output current $I_o$ | $U_{i\,nom}$<br>$I_o = 0...I_{o\,nom}$ | | 40<br>120 | 55<br>160 | | 120<br>170 | 160<br>220 | | 125<br>250 | 160<br>320 | |
| $u_{o\,d}$ | Dynamic control deviation [2] | $U_{i\,nom}$<br>$I_{o\,nom} \leftrightarrow {}^1/_3\ I_{o\,nom}$ | | 180 | | | 210 | | | 250 | | |
| $t_r$ | Dynamic load transient time recovery [2] | | | 60 | | | 80 | | | 100 | | µs |
| $\alpha_{uo}$ | Temperature coefficient $\Delta U_o/\Delta T_C$ | $U_{i\,min}...U_{i\,max}$<br>$T_{C\,min}...T_{C\,max}$<br>$I_o = 0...I_{o\,nom}$ | | | ±3 | | | ±5 | | | ±8 | mV/K |
| | | | | | ±0.02 | | | ±0.02 | | | ±0.02 | %/K |
| **Input** | | | | | | | | | | | | |
| $U_i$ | Input voltage | $I_o = 0...I_{o\,nom}$<br>$T_{C\,min}...T_{C\,max}$ | –19 | | –80 | –29 | | –80 | –42 | | –80 | V DC |
| $\Delta U_{io\,min}$ | Minimum differential voltage $U_i$ - $U_o$ [3] | | | –4 | | | –5 | | | –6 | | V |
| $U_{i\,o}$ | Undervoltage cut-out | | | –7.3 | | | –12 | | | –19 | | |
| $I_{i\,0}$ | No load input current | $I_o = 0$<br>$U_{i\,min}...U_{i\,max}$ | | | 35 | | | 35 | | | 40 | mA |
| $I_{i\,m}$ | Peak value of inrush current [4] | $U_{i\,nom}$ | | 150 | | | 150 | | | 150 | | A |
| $t_{i\,s}$ | Rise time [4] | | | 2.5 | | | 2.5 | | | 2.5 | | µs |
| $t_{i\,r}$ | Tail half value time [4] | | | 15 | | | 15 | | | 15 | | |
| $u_{i\,rfi}$ | RFI level at input, 0.01...30 MHz | VDE 0871 (6.78)<br>$U_{i\,nom}$, $I_{o\,nom}$ | | | A [5] | | | A [5] | | | A [5] | dB (µV) |
| **Efficiency** | | | | | | | | | | | | |
| $\eta$ | Efficiency | $U_{i\,nom}$, $I_{o\,nom}$ | | 88 | | | 91 | | | 94 | | % |
| **Isolation** | | | | | | | | | | | | |
| $U_{is}$ | Isolation test voltage electronics to case | Inputs/outputs interconnected | | 500 | | | 500 | | | 500 | | V DC |

[1] Lower row representents option -9 data only
[2] See “Dynamic Characteristics”
[3] The minimum differential voltage $\Delta U_{io\,min}$ between input and output increases linearly from 0 to 1 V at $T_A$ = 46°C and 71°C ($T_C$ = 70°C and 95°C)
[4] Definitions according to VDE 0433, part 3
[5] With FN 80 and $C_e$ = 470 µF (see "Accessories")

## Characteristics and Definitions

### Output Protection

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

### Dynamic Characteristics

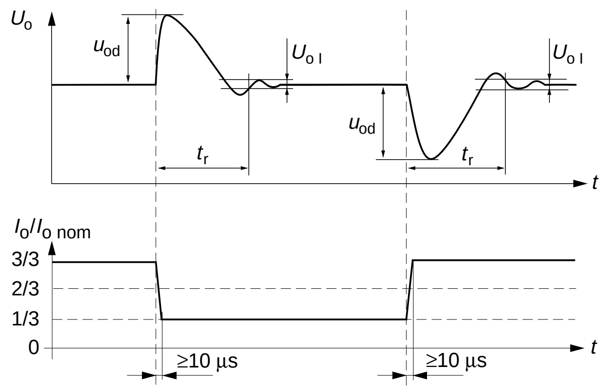



*Fig. 2*
*Behaviour and characteristics under varying load conditions.*

### Temperature

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

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

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

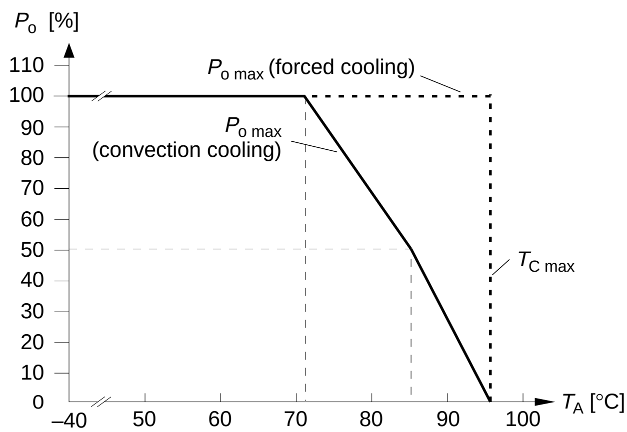



*Fig. 3*
*Output power derating versus ambient temperature*

### Parallel and Series Connection

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

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

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

### Short circuit behaviour

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

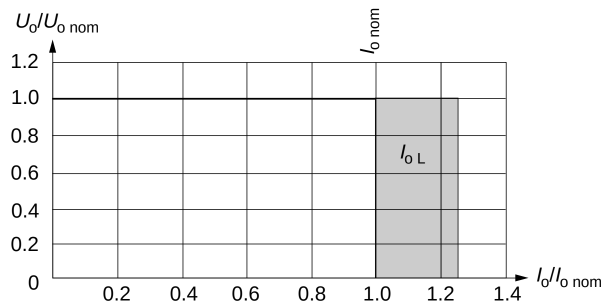



*Fig. 4*
*Overload, short-circuit behaviour $U_o$ versus $I_o$*

## Description of Options

**Option i** Inhibit

**Note:** With open i-input, output is enabled ($U_o$ = on).

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

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

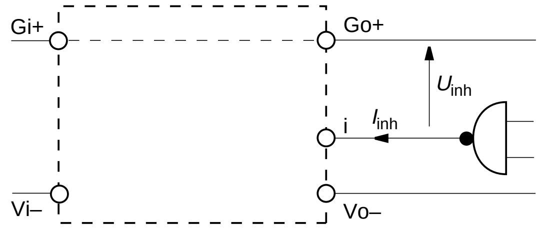



*Fig. 5*
*Definition of $I_{inh}$ and $U_{inh}$*

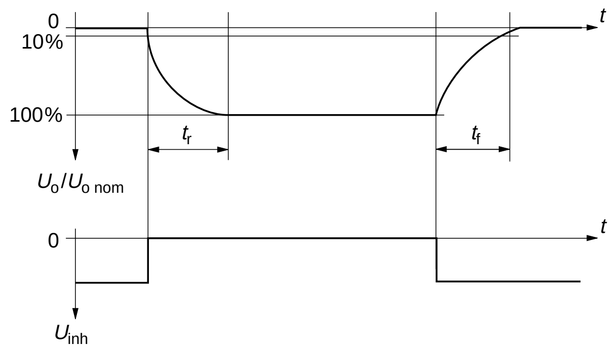



*Fig. 6*
*Output response as a function of inhibit signal*

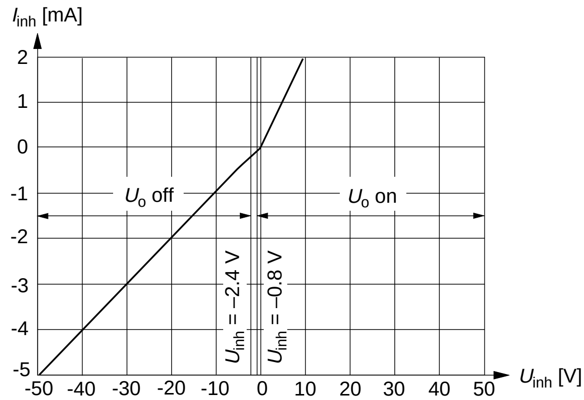



*Fig. 7*
*Inhibit current $I_{inh}$ versus inhibit voltage $U_{inh}$*

*Table 8: Inhibit characteristics*

| Characteristics | | | Conditions | min | typ | max | Unit |
|---|---|---|---|---|---|---|---|
| $U_{inh}$ | Inhibit input voltage to keep regulator output voltage... | $U_o$ = on | $U_{i\,min}...U_{i\,max}$ $T_{C\,min}...T_{C\,max}$ | –0.8 | | +10 | V DC |
| | | $U_o$ = off | | –50 | | –2.4 | |
| $t_r$ | Switch-on time after inhibit command | | $U_i = U_{i\,nom}$ $R_L = U_{o\,nom} / I_{o\,nom}$ | | 2 | | ms |
| $t_f$ | Switch-off time after inhibit command | | | | 4 | | |
| $I_{i\,off}$ | Input current when inhibited | | $I_o = 0$, $U_i = U_{i\,nom}$ | | 10 | | mA |

**Option R** Output voltage adjustment

**Note:** With open R-input, $U_o = 1.08\ U_{o\,nom}$ (Exception: With option Y, $U_o = 1.00\ U_{o\,nom}$)!

The output voltage $U_o$ can be adjusted either with an external resistor $R_{ex}$ or an external reference voltage $U_{ex}$. The adjustment range is 0.65...1.08 of $U_{o\,nom}$ (or 0.65...1.00 of $U_{o\,nom}$ with option Y). The minimum differential voltage $\Delta U_{i\,o\,min}$ between input and output voltages as specified in relevant tables must be maintained.

Option R and P cannot be supported simultaneously.

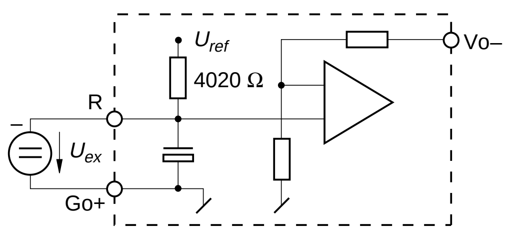



*Fig. 8*
*Voltage adjustment with $U_{ex}$ [V]*

Without option Y: $U_o \approx 1.08 \cdot U_{o\,nom} \cdot U_{ex} / U_{ref}$
With option Y: $U_o \approx U_{o\,nom} \cdot U_{ex} / U_{ref}$
($U_{ref}$ = –2.49 V ±4%)

**Caution:** $U_{ex}$ must neither exceed $U_{ref}$ (1.1 • $U_{ref}$ with option Y) nor be positive, or failure will occur!

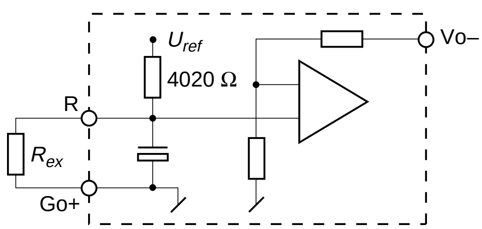



*Fig. 9*
*Voltage adjustment with $R_{ex}$ [Ω]*

Without option Y: $U_o \approx U_{o\,nom} \cdot 1.08 \cdot R_{ex} / (R_{ex} + 4020)$
$R_{ex} \approx 4020 \cdot U_o / (1.08 \cdot U_{o\,nom} - U_o)$

With option Y: $U_o \approx U_{o\,nom} \cdot R_{ex} / (R_{ex} + 4020)$
$R_{ex} \approx 4020 \cdot U_o / (U_{o\,nom} - U_o)$

All formulae give approximate values only.

**Option -9** Extended Temperature Range

The operational ambient temperature range is extended to $T_A = -40...71°C$

**Option P** Potentiometer

Option P excludes R function. The output voltage $U_o$ can be adjusted with a screwdriver in the range from 0.92...1.08 of the nominal output voltage $U_{o\ nom}$.

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

**Option Y** PCB Soldering Pins

This option defines soldering pins of 1.0 × 0.5 × 6.5 mm, instead of the standard fast-on terminals of 2.8 × 0.5 × 6.5 mm. Modules with this option can be mounted onto printed circuit boards, providing through-plated finished hole size of Ø 1.3...1.5 mm.

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

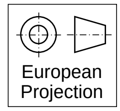
Underwriters Laboratories (UL) have approved the NSR-family as recognized components up to an ambient temperature of $T_{A\ max}$ – 10 K, given by the upper temperature limit of the standard PCB material. If the full maximum ambient temperature $T_{A\ max}$ is required with UL approval, option U should be requested. It consists of an alternative PCB material with a higher maximum temperature specification.

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



## Mechanical Data

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



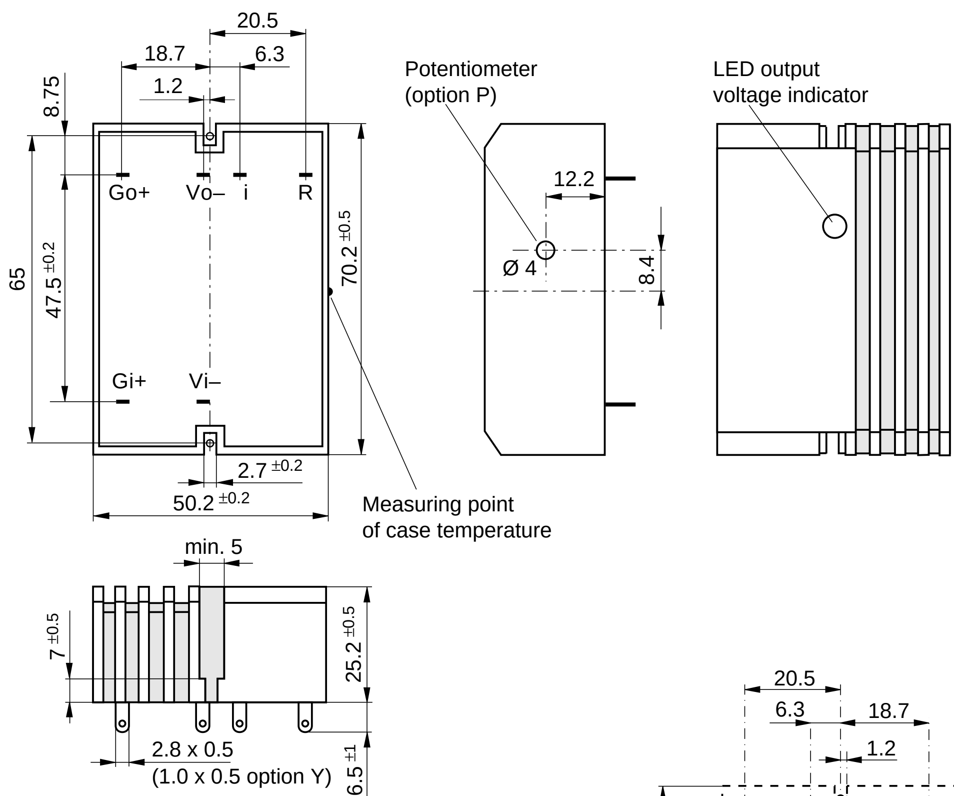




*Fig. 10*
*Case A01 (Weight 100 g)*

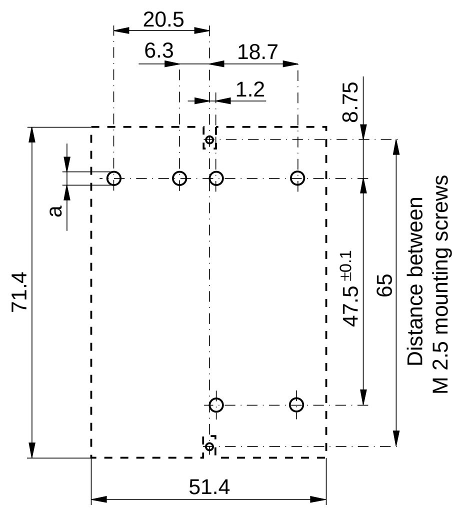



*Fig. 11*
*Case A01 hole locations for circuit board layout (component side view of PCB):*
*- - - = Space reserved for switching regulator*
*"a" = 3.0 mm × 0.7 mm slot or Ø 3.0 mm, through plated for hand or machine soldering (fast on)*
*"a" = Ø 1.3...1.5 mm with option Y pins*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# Type Key and Product Marking

## Type Key

NSR 12 2.5 -7 i R P Y

Negative switching regulator in case A01 .................. NSR
Blank .................................................................................
Nominal output voltage in volt ............................... –5...–36
Nominal output current in ampere .............................. 2...4
Ambient temperature range
$T_A$ = –25...71 °C .................................................. -7
$T_A$ = –40...71 °C .................................................. -9
Inhibit input ........................................................................ i
External output voltage adjustment ................................ R
Potentiometer .................................................................. P
Small soldering pins 0.5 × 1.0 mm .................................. Y

Example:NSR 122.5-7iP = A negative switching regulator with a –12 V, 2.5 A output, ambient temperature range of –25…71 °C, inhibit input and potentiometer.

## Product Marking

Main face: Specific type designation, input voltage range, nominal output voltage and current, applicable safety approval and recognition marks, degree of protection, Melcher patent nos. and company logo.

Cover: Pin allocation and warnings.

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