12 Accessory Products

12.1 Accessories

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Mating Connectors H11/H15/H15 S4

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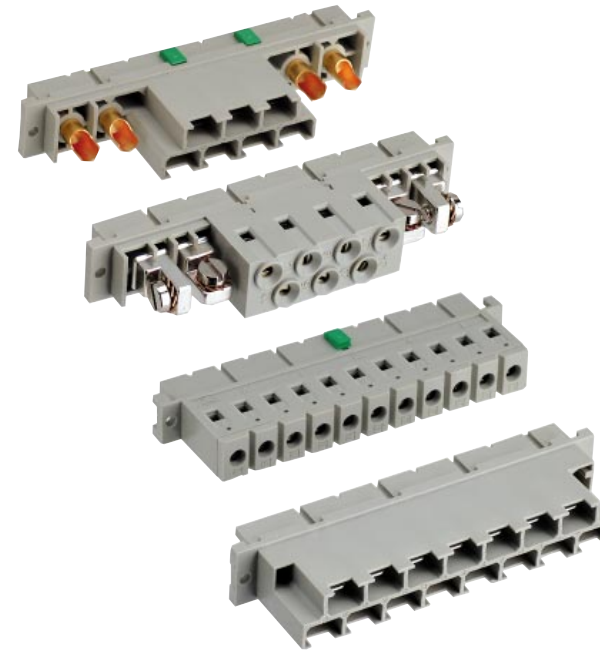


Description

All Melcher 19" cassette type converters are equipped with either H11-, H15- or H15 S4 male connectors. Mating female connectors are available as accessories according to the following tables. The three H-type connector versions are specially designed for power supply applications, capable of handling high operating currents. The connectors have an integrated code key system allowing many coding possibilities. Modules with high output current normally use two contacts in parallel to keep the voltage drop across the connector as low as possible.

H11 Connector

This connector has eleven contacts in one vertical column marked 2 to 32. Mating and mounting conditions are according to DIN 41612. The connector contacts are hard-silver-plated and correspond to quality class 1, with respect to electrical and mechanical life time.

Table 1: H11 Connector Survey

Female connector type	Description of terminals	Integrated coding
STV-H11-F/CO	Faston straight 6.3 × 0.8 mm	yes
STV-H11-FS/CO	Faston straight 6.3 × 0.8 mm, solderable (short moulding)	yes
STV-H11-FSR/CO	Screw terminals, 90°, 2.5 mm² (AWG 13) max,	yes
STV-H11-FB/CO [1]	Solder pin 5.2 mm, ∅ 1.6 mm	yes
STV-H11-FBER/CO [2]	Solder pin 4.3 mm, ∅ 1.0 mm	yes
STV-H11-FP/CO [2]	Press fit 6.5 mm, ∅ 1.0 mm	yes
STV-H11-FBG/CO [2]	Solder pin 5.2 mm, ∅ 1.6 mm, gold-plated contacts	yes

[1] See also matching Flexi-PCB for PCB mounting of converters (see Mounting Supports)
[2] Available on request

This connector type (male version) is used in the following converter families (case size):

H (H02), M (M02), SR (L01) and PSL (L04).

Mechanical Dimensions

All dimensions in mm, tolerances ±0.2 mm unless otherwise specified

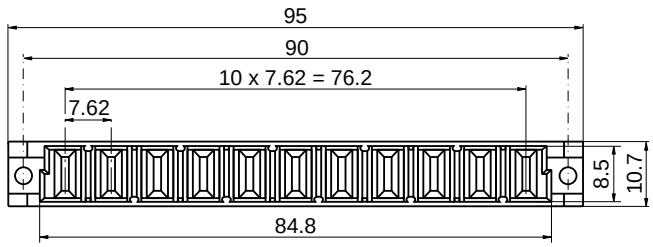


Fig. 1
H11 frontal view, relating to figures 2 to 5

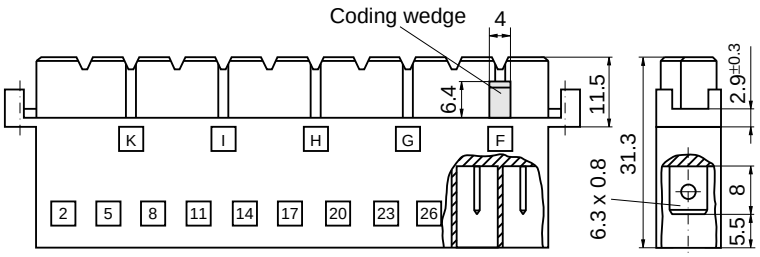


Fig. 2
STV-H11-F/CO,
Faston cable terminals 6.3 × 0.8 mm

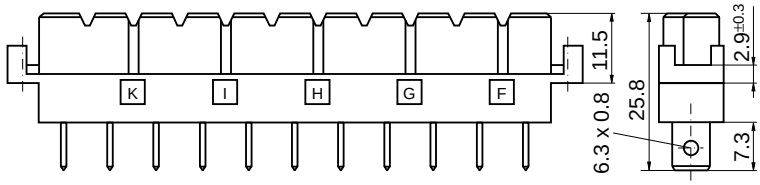


Fig. 3
STV-H11-FS/CO,
Faston cable terminals 6.3 × 0.8 mm,
solderable (short moulding)

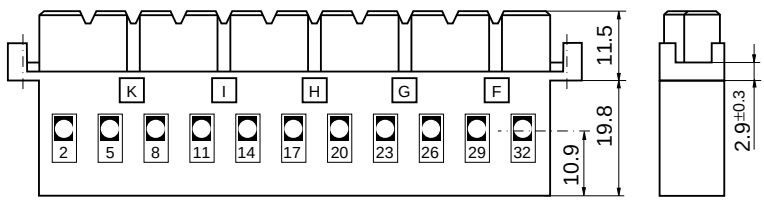


Fig. 4
STV-H11-FSR/CO,
screw terminals (max. 2.6 mm²/AWG 13)

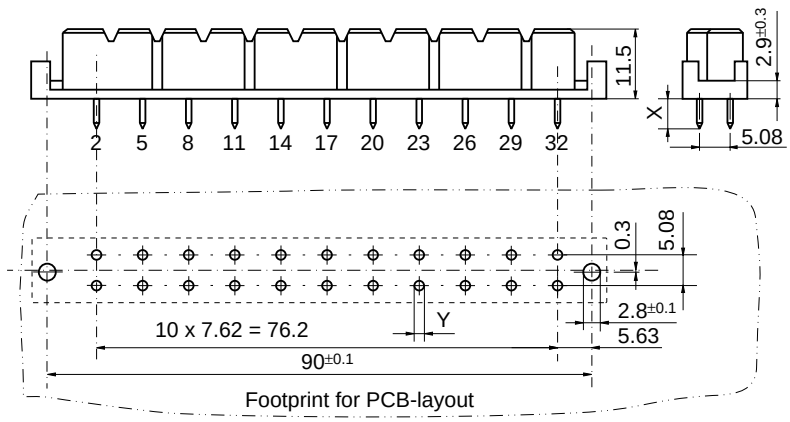


Fig. 5

STV-H11-FB/CO, *soldering pins*	*X = 5.2*	*Y = Ø 1.6*
STV-H11-FBG/CO, *soldering pins*	*X = 5.2*	*Y = Ø 1.6*
STV-H11-FBER/CO, *soldering pins*	*X = 4.3*	*Y = Ø 1.0*
STV-H11-FP/CO, *press insert pins*	*X = 6.5*	*Y = Ø 1.0*

H15 Connector

This connector has fifteen contacts in two vertical columns marked 4 to 32 and is designed to meet DIN 41612. The connector contacts are hardsilver-plated and correspond to quality class 1, with respect to electrical and mechanical life time.

This connector type (male version) is used in the following converter families (case size):

PSS (S01), S (S02), Q (Q01) and for PSK (K01) and K (K02) only for output current ≤18 A.

Table 2: H15 Connector Survey

Female connector type	Description of terminals	Integrated coding
STV-H15-F/CO	Faston straight 6.3 × 0.8 mm	yes
STV-H15-FSR	Screw terminals, 90°, 2.5 mm² (AWG 13) max.	no
STV-H15-FB/CO	Solder pin 4.0 mm, ∅ 1.6 mm	yes
STV-H15-FP/CO [1]	Press fit 6.5 mm, ∅ 1.0 mm	yes
STV-H15-FBG/CO [1]	Solder pin 4.0 mm, ∅ 1.6 mm, gold-plated contacts	yes

[1] Available on request

Mechanical Dimensions

All dimensions in mm, tolerances ±0.2 mm unless otherwise specified

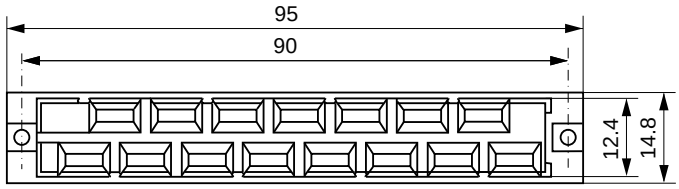


Fig. 6
H15 frontal view,
relating to figures 7 and 8

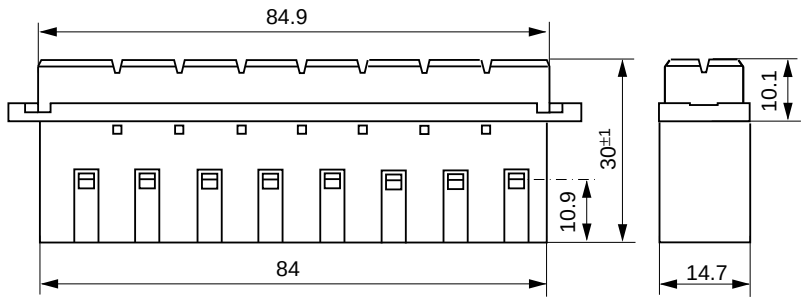
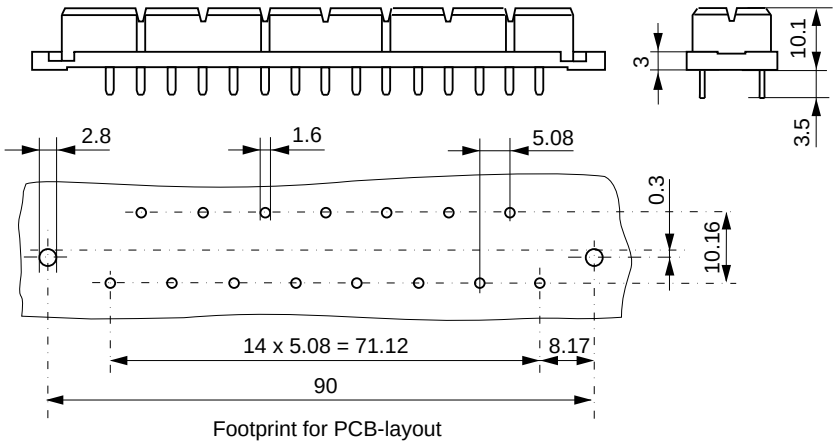


Fig. 7
STV-H15-FSR,
Screw terminals, no coding
STV-H15-F/CO,
Faston cable terminals 6.3 × 0.8 mm
(identical dimensions, but not shown)



Footprint for PCB-layout

Fig. 8
STV-H15-FB/CO,
soldering pins

12.1

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H15 S4 Connector

This special connector is a derivative of the H15 having seven standard contacts as above, combined with four high current contacts according to DIN 41626. The high current contacts are specially designed to handle currents from 20 A up to 50 A. They correspond to quality class 1, with respect to electrical and mechanical life time. The contact material is high quality Beryllium-Copper (CuBe treated) with a gold-plated surface.

To install the high current contacts carefully follow the assembly instructions. It is extremely important to solder cables, screw cable terminals or heat shrink sleeves to high current jacks first, before inserting them into the moulding. Paralleled converters should preferably be interconnected on current bars or at a star point.

Using screw versions, the two outer high current jacks may be inserted at a 90° angle in order to prevent possible short circuits between the cable terminals, especially in applications with high vibration environment. Heat shrink sleeves might be necessary for further isolation purposes or to keep clearance and creepage distances at specified levels.

An Extraction Tool allows removal of the high current contacts for replacement (see Extraction Tool).

Caution: The use of an adequate cable strain relief device (e.g. Cable Hood etc.) is essential in order to protect the high current contact jacks from damage. Never screw, solder or manipulate S4-contacts when the connector is plugged into the male connector! The use of highly flexible cables is strongly recommended.

This connector type (male version) is used in the following converter families (case size):

PSK (K01) and K (K02) with output current ≥20 A.

Table 3: H15 S4 Connector Survey

Female connector type	Description of terminals	Integrated coding
STV-H15 S4-F/CO	7 Faston straight 6.3 × 0.8 mm, set of 4 solder jacks [1]	yes
STV-H15 S4-FSF/CO	7 Faston straight 6.3 × 0.8 mm, set of 4 screw jacks [1]	yes
STV-H15 S4-FLS/CO	7 screw terminals, 90°, 2.5 mm², set of 4 solder jacks [1]	yes
STV-H15 S4-FSR/CO	7 screw terminals, 90°, 2.5 mm², set of 4 screw jacks [1]	yes

[1] Spare set of high current jacks are available on request

Delivery content: H15 S4-moulding, four high current jacks and assembly instructions. Screw versions also include four M4 screws with washers and heat shrink sleeves.

Mechanical Dimensions

All dimensions in mm, tolerances ±0.2 mm unless otherwise specified

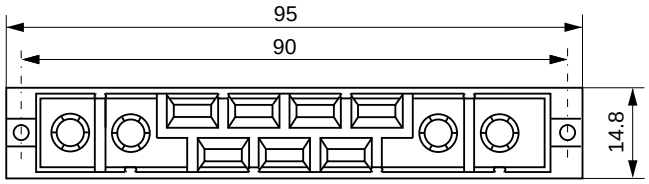

Fig. 9
H15 S4 frontal view,
relating to figures 10 and 11

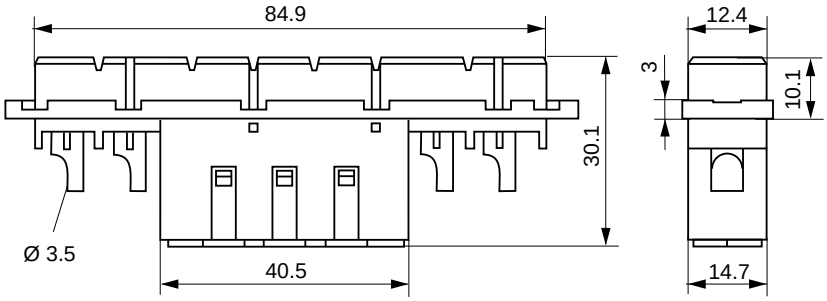

Fig. 10
STV-H15 S4-FLS/CO,
screw terminals and four high current soldering terminals

STV-H15 S4-FSR/CO,
screw terminals and four high current screw terminals (not shown)

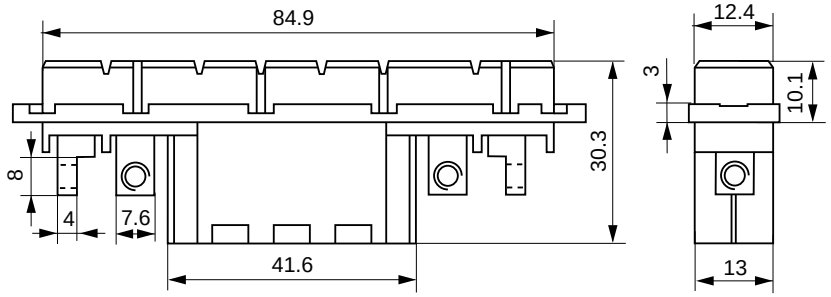

Fig. 11
STV-H15 S4-FSF/CO,
Faston cable terminals and four high current screw terminals

STV-H15 S4-F/CO
Faston cable terminals and four high current soldering terminals (not shown)

Technical Data

Table 4: Connector data

Type	H11	H15	H15 S4 Standard	H15 S4 High current
Mechanical data				
Number of poles	11	15	7	4
Mating cycles	500	500	500	500
Insertion/withdrawal forces max.	80 N	90 N	90 N	10/1.6 N
Electrical data				
Clearance distance contact/ground	≥4.5 mm	≥4.5 mm	≥4.5 mm	
Creepage distance contact/contact	≥8.0 mm	≥8.0 mm	≥8.0 mm	
Test voltage Vrms	3100	3100	3100	
Operation voltage V AC	500	500	500	
Operation current per contact T_A 20°C T_A 70°C T_A 95°C	20 A 17 A 14 A	15 A 12 A 9 A	15 A 12 A 9 A	40 A 35 A 25 A
Contact resistance	≤8 mΩ	≤8 mΩ	≤8 mΩ	≤1 mΩ
Isolation resistance at 100 V DC	≥10^{12} Ω	≥10^{12} Ω	≥10^{12} Ω	
Miscellaneous data				
Operating temperature	–55...125 °C	–55...125 °C	–55...125 °C	
Contact surface	6 µm Ag	6 µm Ag	6 µm Ag	1.3 µm Au
Moulding material	PBTP/PC	PBTP/PC	PBTP	
Flammability	UL 94V-0/UL 94 V-1	UL 94 V-0/UL 94 V-1	UL 94 V-0	
Approvals				

Code Key System

An efficient coding system is of great importance and cannot be valued highly enough in complex electronic systems. Since power supplies handle high currents and voltages any false connection could not only be extremely dangerous but also quite costly.

This integrated polarizing system allows effortless coding by the simple insertion of Coding Wedges into the female connector mouldings. The corresponding counter-parts, i.e. the coding tabs of the male moulding just have to be broken off to match the right female part. Major advantages are high mechanical stability and ease of handling. The H11 connectors have 10 and the H15 connectors have 8 coding positions. Using 4 coding wedges results in 210 (H11) respectively 70 (H15) different coding possibilities. Coding wedges are available as accessories to female connectors with the following part number:

Description: Coding Wedge (Codierkeil)
Delivery content: 5 pcs.

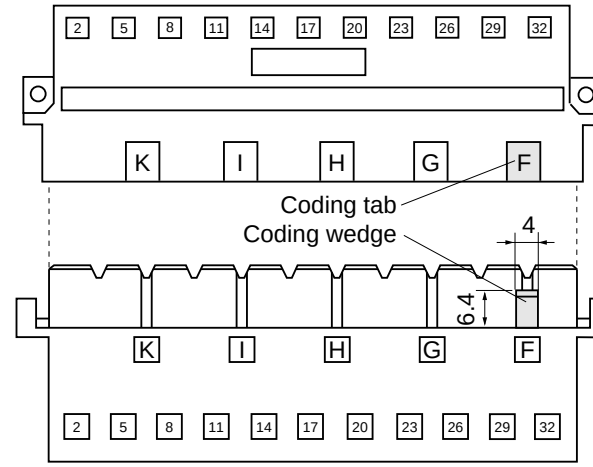

Fig. 12
Integrated code key system

12.1

Extraction Tool for High Current Contacts

High current plugs and jacks can be disassembled from the moulding by means of a special Extraction Tool (H15 S4). Holding the extraction tool over the centre of the connector's female contact the outer part of the extraction tool should be fed between the moulding and the outside of the female contact itself. This releases the spring clip fixing the contacts, in order to pull the contacts out of their moulding for replacement. If the operation is performed correctly very little force is required. Extreme care should be taken since incorrect procedure and excessive force could damage the tool and/or connector.

This tool is available as an accessory for both screw or solder high current contacts.

Note: In order to avoid damage never manipulate high current contacts when plugged-in!

Description: Extraction Tool

Fig. 13
Extraction tool

Connector Retention Clip V

The retention clip V is an accessory which guarantees secure connection even under severe vibration, as for example in mobile applications. One connector retention system fits to almost all units and all of the aforementioned connector types.

The following converter families are delivered with prepunched holes in the back plate for fast field-mounting of retention clips:

H, M, K, PSK, S and PSS (Q family only in combination with Mounting Plate Q, see Mounting Supports)

Description: Retention Clips V
Delivery content: 2 pcs.

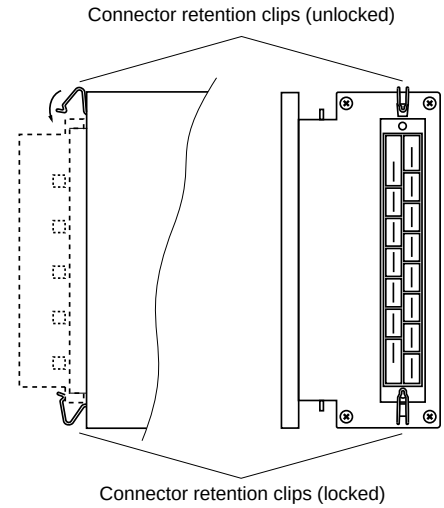

Fig. 14
Connector retention clip

Cable Hood

A cable connector housing or Cable Hood is available for all female H15 and H15 S4 type connectors. It serves as a strain relief, isolates connections and protects cables.

Descriptions: KSG-H15/H15 S4
Delivery content: Housing shell, cable duct with covers, cable clip, cable boot and screws

If using the cable hood together with retention clips a special version is available, where both sides of the hood are slightly modified on each side in order to allow for insertion of the clips. The cable hood with retention clips has been tested to withstand vibrations according to IEC 86-2-6: 5 g, 6 directions, 2.5 hours per axis.

Descriptions: KSG-H15/H15 S4-V
Delivery content: Housing shell, cable duct with covers, cable clip, cable boot and screws

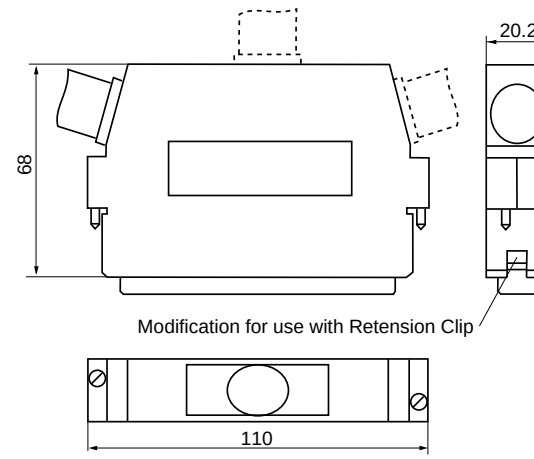

Fig. 15
Cable hood for H15 and H15 S4 connectors

Front Panels for Melcher Power Supplies

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Description

Front panels are available for 19" rack mounting of 3 U cassette type power supplies in *"Schroff"* system version (*"Intermas"* on request) and may be attached to the converter by means of countersunk screws.

An assembly kit, consisting of a front panel and a support bracket, enables arrangement of two standard cassettes with up to six output voltages in 6 U configuration.

All front panels are of colourless anodised aluminium and delivered with one or two grey plastic handles of 3 TE for easy pull-out and two or four hand-press insertable plastic retainers with captive screws for fixing to the rack.

Note: Front panel mounting or custom specific front panels are available on request.

Dimensions in accordance to DIN 41494-1 (IEC 297):
Height: 1 U = 44.45 mm (1.750 in)
Width: 1 TE = 5.08 mm (0.20 in)
Tolerances ±0.2 mm, unless otherwise specified

Schroff System for 3 U Rack

Q-Family Front Panels in 4, 5 or 6 TE

This front panel in three versions fits to all 100 Watt DC-DC converters of the 24...48Q and B...DQ Family with case size Q01.

Table 1: Q01 case front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
4	20.0	Q01	Q	G04-Q01
5	25.1	Q01	Q	G05-Q01
6	30.2	Q01	Q	G06-Q01

Note: For use of several Q-units next to each other, we advise to pack them not too densely in order to assure good thermal management (see also Q-data sheet).

Delivery contents:
Front panel, grey plastic handle, three countersunk screws, set of two plastic retainers with captive screws and assembly instructions.

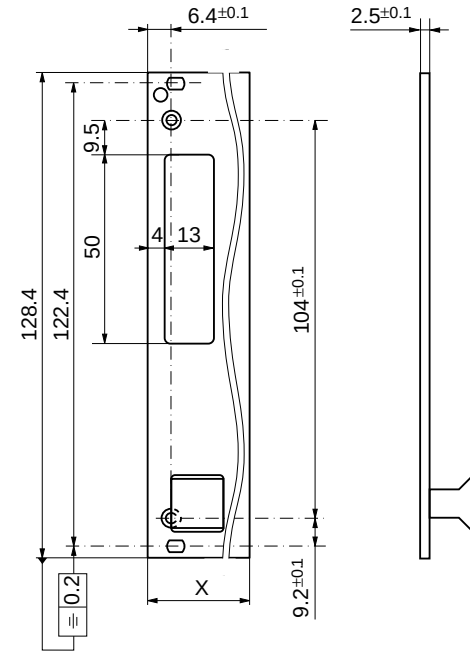

Fig. 1
Front panel for Q01 case size

H- and M-Family Front Panel in 8 TE

This front panel fits to all 50 Watt DC-DC and AC-DC converters of the 12...230H-Family with case size H02 as well as to all AM...LM- and CMZ...LMZ-Family versions with case size M02.

Table 2: H02 and M02 case front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
8	40.3	M02	M	G08-M02
8	40.3	H02	H	G08-M02

Note: Front panels for the superseded M-Mk I version are available on request.

Delivery contents:
Front panel with grey plastic handle, two countersunk screws, set of two plastic retainers with captive screws and assembly instructions

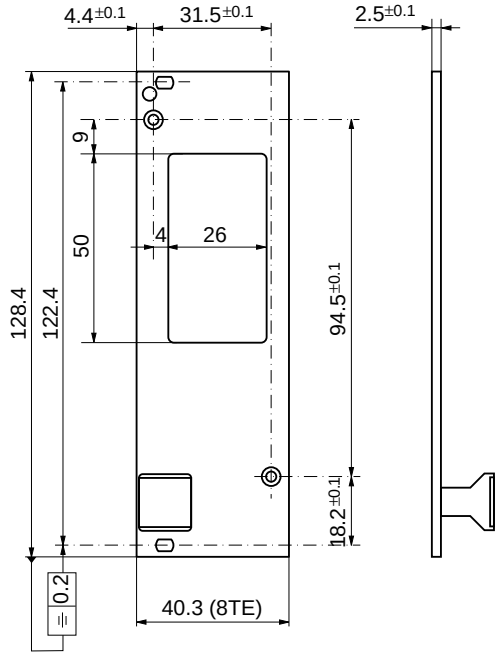

Fig. 2
Front panel for H02 and M02 case size

PSL- and SR 20E-Family Front Panel in 8 TE

This front panel fits to all Switching Regulators of the PSL-Family with case size L04 and to all 20 Watt DC-DC and AC-DC converters of the B...LSR-Family with case size L01.

Table 3: L case front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
8	40.3	L04	PSL	G08-L [1]
8	40.3	L01	SR20E	G08-L

[1] Exception: PSL with option D is part no. G08-L04-D, HZZ 00816

Note: This front panel is a compatible replacement for all earlier versions of the same size, published in any previous front panel data sheet.

Delivery contents:
Front panel with grey plastic handle, two countersunk screws, set of two plastic retainers with captive screws and assembly instructions.

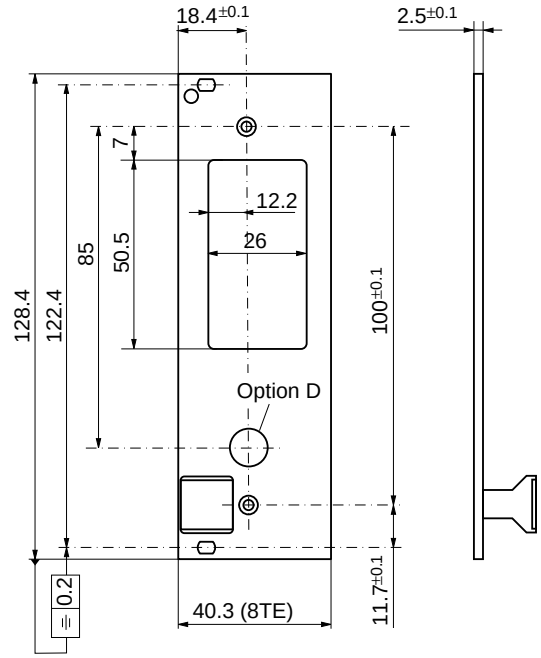

Fig. 3
Front panel for L01 and L04 case size

PSS- and S-Family Front Panels in 12 TE
PSK- and K-Family Front Panels in 16 TE

This front panel fits to all Switching Regulators of the PSS- and PSK-Family with case size S01 or K01 as well as to all 100...150 Watt DC-DC and AC-DC converters of the A...LS- and A...LK-Family with case size S02 or K02 according to the selection table below:

Table 4: S and K case front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
12	60.6	S01 S02	PSS S	G12-S
16	81.0	K01 K02	PSK K	G16-K

Delivery contents:
Front panel with grey plastic handle, two countersunk screws, set of four plastic retainers with captive screws and assembly instructions.

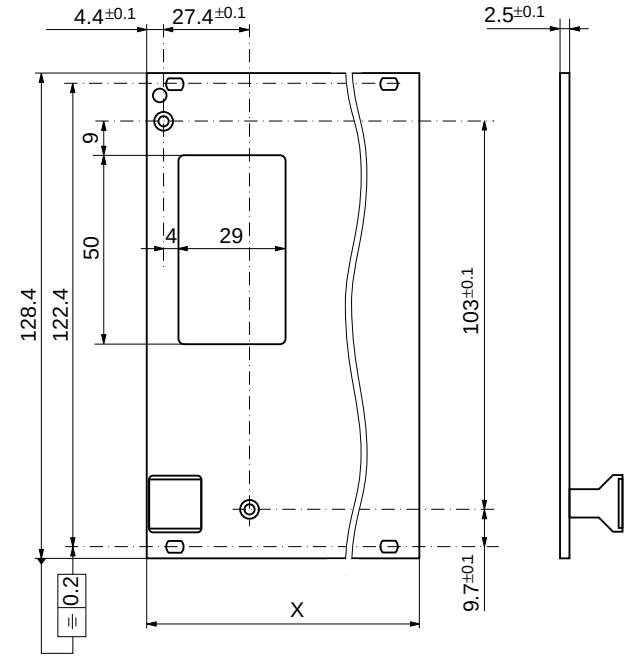

Fig. 4
Front panel for S01, S02, K01 and K02 case size

T-Family Front Panel in 28 and 26 TE

This front panel fits to all 500 Watt AC-DC converters of the T-Family with case size T01.

Table 5: T case front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
28	141.9	T01	T	G28-T01
26	131.7	T01 [1]		G26-T01

[1] With option B1

Delivery contents:
Front panel with two grey plastic handles, three countersunk screws, set of four plastic retainers with captive screws and assembly instructions.

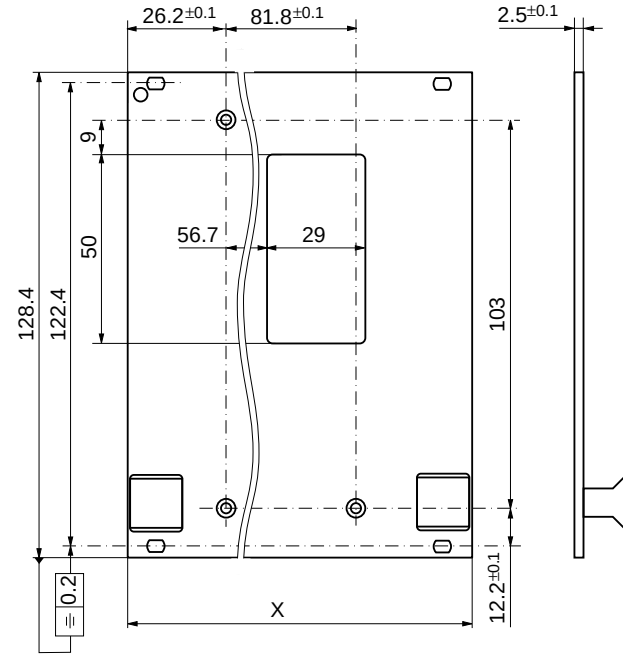

Fig. 5
Front panel for T01 case size

12.1

Intermas System for 3 U Rack

The major differences between the Intermas and the Schroff system front panels are the thickness (2 mm instead of 2.5 mm), the hole size for the plastic retainers and a small cut-out on each side (see figure 6). All other dimensions are given in the relevant Schroff front panel drawings.

The following Intermas front panels are available on request:

Table 6: Intermas front panel selection

X		Case size	Converter family	Type, Part No.
TE	mm			
8	40.3	H02 M02	H, M	F08-M02
8	40.3	L01 L04	PSL SR 20E	F08-L
12	60.6	S01 S02	PSS, S	F12-S
16	81.0	K01 K02	PSK K	F16-K

Delivery contents:
Front panel with grey plastic handle, two countersunk screws and assembly instructions.

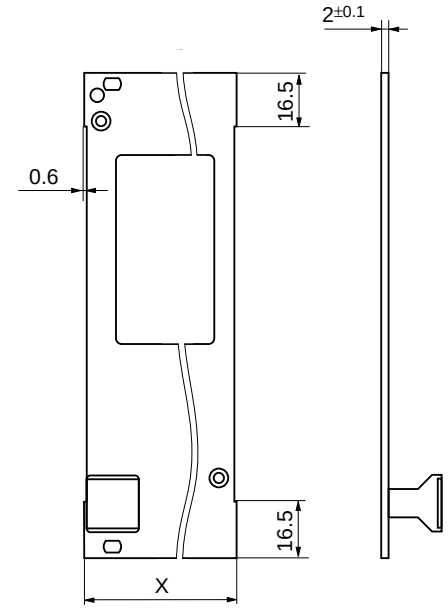

Fig. 6
Intermas system front panel (various case sizes)

Schroff System Kit for 6 U Rack

To configure Melcher Power Supplies for use in 6 U racks a special assembly kit has been created consisting of a double height front panel together with a support bracket for two converters as shown in figure 7.

All other dimensions are given in the relevant 3 U front panel drawings according to their case size. The assembly kit is available with the type designation according to the following table:

Table 7: 6 U assembly kit selection

X		Case size	Converter family	Type, Part No.
TE	mm			
5	25.1	Q01	Q	Kit-G05-6HE-Q01
8	40.3	H02 M02	H M	Kit-G08-6HE-M02
12	60.6	S01 S02	PSS S	Kit-G12-6HE-S
16	81.0	K01 K02	PSK K	Kit-G16-6HE-K

Delivery contents:
Double height front panel with two grey plastic handles, four countersunk screws, set of two plastic retainers with captive screws, a support bracket and assembly instructions.

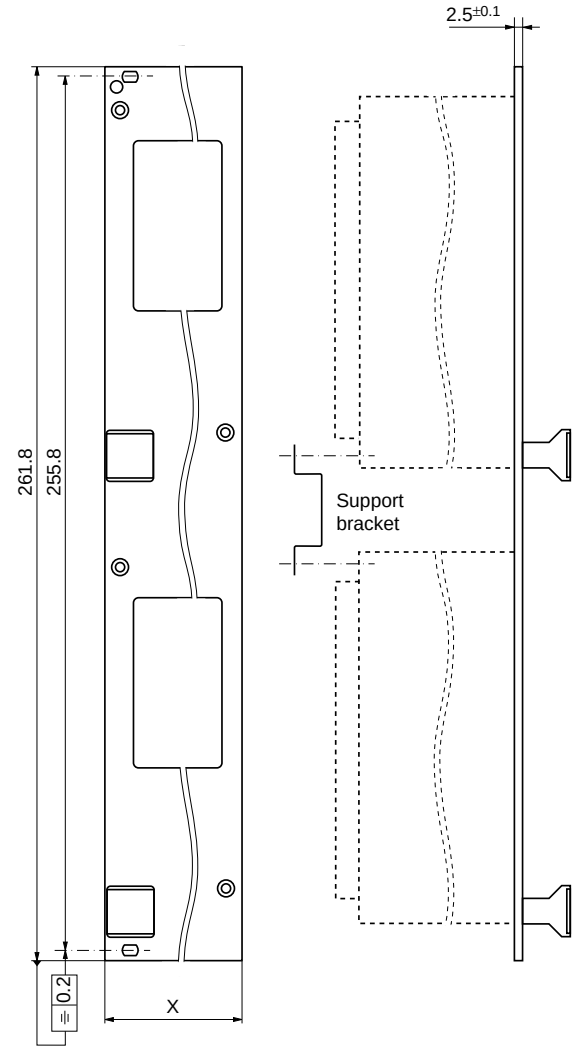

Fig. 7
Front panel for 6 U configuration (various case sizes)

Filters and Ring Core Chokes FN/FP/L/LP-Series

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Description

Filters and chokes are designed to reduce input interference and/or output ripple voltages occurring in applications with switched mode power supplies. Since all filters contain a Moly Permalloy Powder (MPP) ring core they feature very low DC losses as well as high DC magnetisation and operate perfectly at the input and/or output of switching regulators ensuring effective filtering even at elevated DC current levels. These special characteristics allow the chokes to be operated (unlike ferrite core chokes where inductance rapidly decreases above a certain DC magnetising level) at DC currents which considerably exceed the rated current, by accepting a corresponding gradual loss of inductance.

In applications where switching regulators have long supply lines, filters and chokes are used in order to prevent oscillations caused by their negative input impedance. For further information refer also to switching regulator data for "Option L", and to section "Application Notes, Supplementary Data for Switching Regulators".

Table 1a: Type survey of FP filter blocks

Filter Type	Matching Switching Regulator Type
FP 38	PSR 54 PSA 55 PSA 5A2 PSA 5A5 PSA 123 PSA 153
FP 80	PSR 53 PSR 122.5 PSR 152.5 PSR 242 PSR 362 PSA 242.5
FP 144	PSA 121.5 PSA 151.5 PSA 241.5 PSA 361 PSA 481

Table 1b: Type survey of FN filter blocks

Filter Type	Matching Switching Regulator Type
FN 38	NSR 54 NSA 55
FN 80	NSR 53 NSR 122.5 NSR 152.5 NSR 242 NSR 362

Table 1c: Type survey ring core chokes

Type	Inductivity	I_{Ln}	Single coil	Symm. coil	Mounting
L 20-7	20 µH	7 A	•		chassis
LP 20-7	20 µH	7 A	•		PCB
LP 34-3	34 µH	3 A	•		PCB
LP 183	2 × 183 µH	8 A		•	PCB

Filter Blocks FN/FP Types

The filter blocks contain, apart from the MPP ring core, a capacitor and an attenuation resistor, capable of handling the high ripple currents seen at the input of switching regulators. This forms an entire external filter system optimised to prevent oscillations and to reduce superimposed interference voltages and currents, specially designed for use in PCB applications together with switching regulators in A01 case size. For selection of filters refer to the type survey.

12.1

Electrical Data Filter Blocks

General Condition: T_A = 25°C unless otherwise specified

Table 2: Filter blocks FP/FN

Characteristics		Conditions	FP 38/FN 38			FP 80/FN 80			FP 144			Unit
			min	typ	max	min	typ	max	min	typ	max	
I_{Fn}	Rated current	L = 0.75 L_o		4			4			2		A DC
U_{Fn}	Rated voltage	$T_{C\,min}$...$T_{C\,max}$	5		40	5		80	15		144	V DC
R_F	Ohmic resistance		18	20	22	18	20	22	90	95	100	mΩ
L_o	No load inductance	I_L = 0, $T_{C\,min}$... $T_{C\,max}$	30	34	38	30	34	38	88	100	112	µH
T_A	Ambient temperature	I_F = I_{Fn}	–40		80	–40		80	–40		95	°C
T_C	Case temperature		–40		92	–40		92	–40		98	
T_S	Storage temperature		–40		100	–40		100	–55		100	

For currents I_F > 4 A the following derating takes place: $T_{A\,max}$ = 100 – 1.3 • I_F^2 [°C], $T_{C\,max}$ = 100 – 0.49 • I_F^2 [°C]

Input Interference Reduction

An AC ripple current can be measured at the input of any switching regulator, even if they are equipped with an input filter. Depending on the types of filters used, common and/or differential mode interferences can be reduced. They will also help to further increase the surge and burst immunity of the power supplies.

The FN/FP filters increase the source impedance of regulators superimposed interference considerably, to a value which is normally high in comparison to the impedance of the source (Z_{Line}). The interference currents are therefore practically independent of their source impedance. The filter will reduce these currents by approximately 25 dB at a frequency of 150 kHz.

The interference voltages at the filter input are due to the remaining interference currents flowing through the source impedance. The resulting interference voltage reduction can be seen in the following figure. For frequencies above the regulator switching frequency the attenuation will increase (up to 2 MHz approx.).

Parallel operation: When several switching regulator inputs are connected in parallel, each regulator should be equipped with a separate input filter. Interconnections should only be made in front of the filter or at its input Uii (i. e. the central ground point should be before or at the filter and under no circumstances at the regulator input).

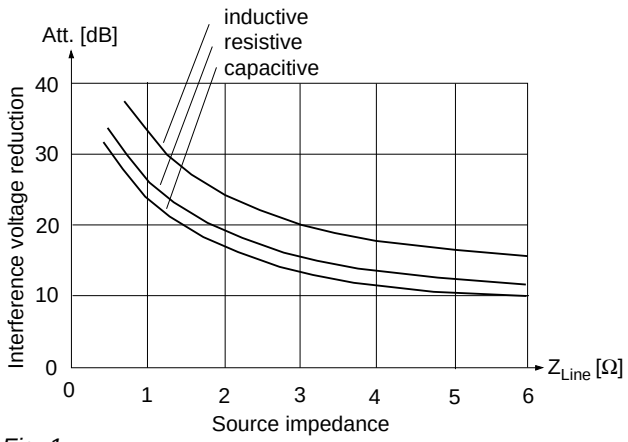

Fig. 1
Interference voltage reduction with FN/FP filters at f = 150 kHz

Reduction of Output Ripple

Even though Melcher switching regulators have an inherently low output ripple, certain sensitive applications need even further reduction. In such cases, the filters designed to reduce disturbances at the input, can also be used for reducing the ripple on the output voltage. (Even better results with regard to the ripple and dynamic control deviation can be achieved by using Melcher low-loss ring core chokes in combination with an external capacitor, see below)

The output ripple can be reduced by the use of Melcher filter blocks by about 24 dB. The formula for the ripple u_R at the load R_L is as follows:

$$u_R = 0.063 \cdot u_o$$

(Ripple voltage u_o is given for specific regulators in the corresponding data section).

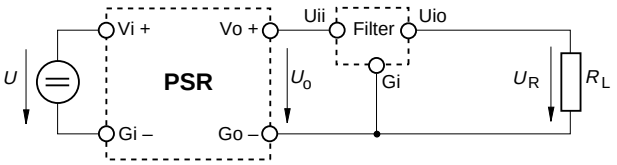

Fig. 2
Reduction of voltage interference by FN/FP filters

Consider, that the filter not only affects the output ripple but can also influence the voltage across the load R_L in the event of load changes. The static load regulation increases with the ohmic resistance of the choke i.e. 24 mV/A for the FP/FN 38 and FP/FN 80 filters and 95 mV/A for the FP 144 filter.

Typical Application:

The example in figure 2 shows a switching regulator operating from a battery (R_i < 0.5 Ω) with long supply lines (e.g. 2 m). The resulting superimposed interference voltage U_{SL} may be measured at the regulators input. The connection of a filter in front of the power supply will reduce this interference accordingly:

1. The regulator's source impedance is mainly inductive because of the low battery impedance and the long supply lines. It can be calculated as follows:

$$|Z_{Line}| \cong 2\pi \bullet f_S \bullet L_{Line} \bullet 2\,l$$

$$|Z_{Line}| \cong 2\pi \bullet (150 \bullet 10^3) \bullet 10^{-6} \bullet 2 \bullet 2 \cong 3.8\ \Omega$$

f_S: Switching frequency (150 kHz)

L_{Line}: Supply line inductance (1µH/m)

l: Length of single supply line (twice for positive and negative path)

2. This example shows, that with an inductive source impedance of 3.8 Ω, the insertion of the filter results in an interference voltage reduction of approx. 18 dB (see fig. 1).
3. The original superimposed interference voltage will be reduced by a factor of approx. 8:

$$U_{SF} = U_{SL} \bullet 10^{-18/20}\ [V]$$

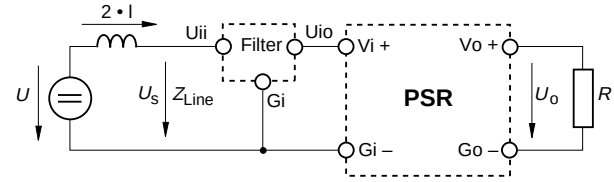

Fig. 3
Reduction of voltage interference by FN/FP filters

Low-Loss Ring Core Chokes L/LP-Series

The ring core chokes, in combination with a capacitor, may easily be used for application specific LC filters at the input or output of switched mode power supplies. All chokes are suitable for PCB mounting. They are either moulded into plastic cases or isolated from the PCB by means of an isolation pad.

Series L/LP 20-7 and LP 34-3 are intended for use as differential mode filters and the current compensated choke LP 183 enables attenuation of common mode interference.

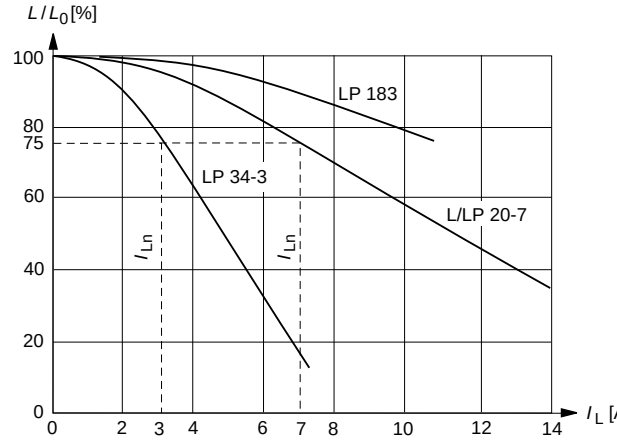

Fig. 4
Choke inductivity vs. current

Electrical Data Ring Core Chokes

General Condition: T_A = 25°C unless otherwise specified

Table 3: Ring core chokes

Characteristics		Conditions	L 20-7/LP 20-7			LP 34-3			LP 183			Unit
			min	typ	max	min	typ	max	min	typ	max	
I_{Ln}	Rated current [1]	L = 0.75 L_o		7			3			8		A DC
R_L	Ohmic resistance		5	5.5	6	18	20	22	2×2.9	2×4.2	2×5.5	mΩ
L_o	No load inductance	I_L = 0, $T_{C\,min}$...$T_{C\,max}$	18	20	22	30	34	38	2×95	2×183	2×245	µH
Δ_{TI}	Current specific case temp. increase [1]			0.082			0.68			0.19		K/A²
T_A	Amb. temperature [1]	$I_L = I_{Ln}$	–40		106	–40		104	–40		98	°C
T_C	Case temperature		–40		110	–40		110	–40		110	
T_S	Storage temperature		–40		110	–40		110	–40		110	

[1] If the choke is not operating at the rated current I_{Ln}, the maximum ambient temperature $T_{A\,max}$ and the maximum direct current $I_{L\,max}$ change according to the following equations:

$$I_{L\,max} = \sqrt{\frac{T_{C\,max} - T_{A\,max}}{\Delta_{TI}}} \qquad T_{A\,max} = T_{C\,max} - I_{L^2\,max} \bullet \Delta_{TI}$$

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Input Interference Reduction

Using L- or LP-series chokes together with an additional external capacitor a similar attenuation can be achieved as with filter blocks. The capacitor between the choke and the converter input is necessary in order to avoid possible oscillations caused by the negative input impedance of the regulator. This phenomenon could cause the input voltage to leave the specified regulator input range. The relatively high ripple current flowing through the capacitor must be considered for the design. Refer also to Application Notes.

The current compensated choke LP 183 has a high permeability ring core with two identical separate windings.

The normal operating current will only see the small stray inductance between the windings. However common mode interference will be blocked by the full inductance of the choke.

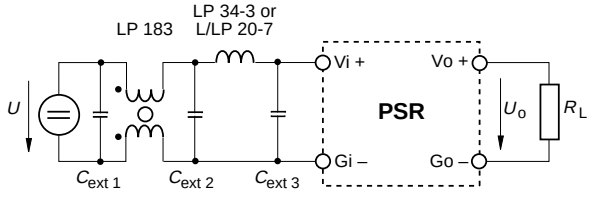

Fig. 5
L/LP type chokes and capacitors used as input filter

Reduction of Output Ripple

Even though Melcher switching regulators have an inherently low output ripple, certain sensitive applications need even further reduction. In such cases, the Melcher low-loss ring core chokes designed to reduce disturbances at the input, can also be used for reducing the ripple on the output voltage. The chokes in combination with an external capacitor can achieve even better results than the Filter Blocks with regard to the ripple and dynamic regulation.

The formula for the remaining output ripple at the load R_L is calculated as follows:

$U_R = u_o \bullet Z_{Cex} / Z_{LD}$

u_o: Output ripple of the regulator

Z_{Cex}: The impedance of the capacitor at the regulator's switching frequency (150 kHz) corresponds to the equivalent series resistance (ESR) of the capacitor (please refer to the corresponding data sheet).

$Z_{LD} = 2\,\pi \bullet f_S \bullet L_D$

f_S: 150 kHz (regulator switching frequency)

L_D: See table 1c and fig. 4

Through the use of a common mode choke LP 183, the common mode noise at the output can also be further reduced.

Consider that the filter not only affects the output ripple but can also influence the voltage across the load R_L in the event of load changes. The static regulation increases with the ohmic resistance of the choke, i.e. 6 mV/A for the choke L/LP 20-7 and 20 mV/A for the LP 34-3.

The dynamic regulation is dependent on the size of the capacitor. Generally, the bigger C_{ex} the smaller is the dynamic, however, recovery will be slower.

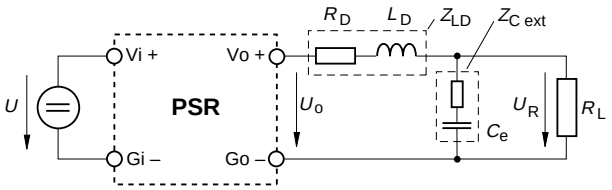

Fig. 6
Melcher low-loss ring core choke with external capacitor (C_{ex} approx. 1000 µF) used as output filter

Typical Application

A voltage drop $U_{rGo} = r_{Go} \bullet (I_o - I_i)$ is produced across the ground loop resistance r_{Go}. It is superimposed upon the regulators output voltage U_o and generates the voltage $U_R = U_o - U_{r\,Go}$ across the load resistance R_L. Without an input inductance L_e the current I_i in the input circuit has a relatively high AC component with a basic frequency f_s (regulator's switching frequency of approx. 150 kHz). This alternating current produces an AC voltage component across r_{Go} which is superimposed upon U_{RL}.

To prevent this phenomenon, an inductance L_e is inserted into the input circuit. This causes the AC component of the input current to be supplied entirely from the input capacitor C_e; thus, I_i is a pure direct current. C_e should be wired as close as possible to the regulator's input terminals Vi+ and Gi–.

L_e and C_e additionally provide protection against input transients and reduce radio interference voltages.

External connection of Gi– and Go– or connection via a common ground is not recommended. The internal voltage drop U_{rG} in the regulator would be superimposed on the output voltage.

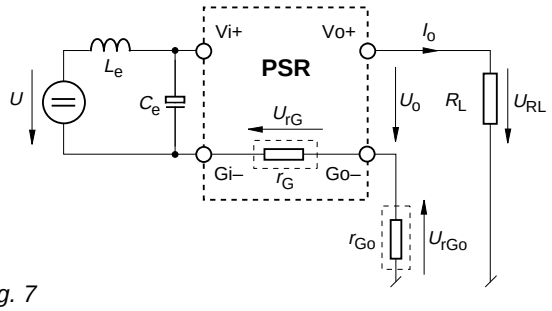

Fig. 7
Decrease of superimposed interference voltages in grounded power supply systems, caused by ground loops

Mechanical Dimensions

Dimensions in mm. Tolerances ±0.2 mm unless otherwise specified

European Projection

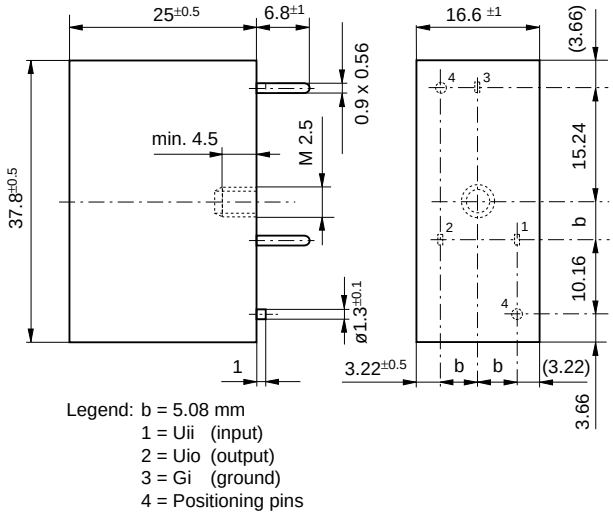

Fig. 8
Filter blocks FP/FN, weight 30 g

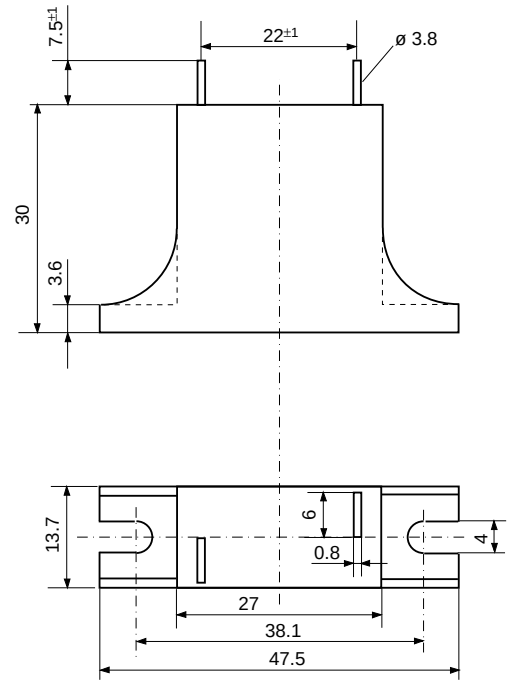

Fig. 9
Differential mode choke L 20-7, weight 30 g

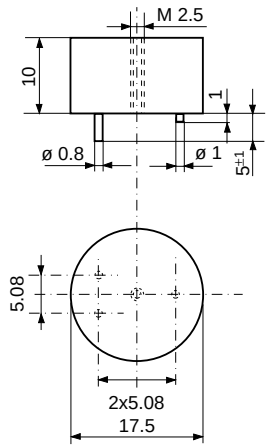

Fig. 10
Differential mode choke LP 34-3, weight 7 g

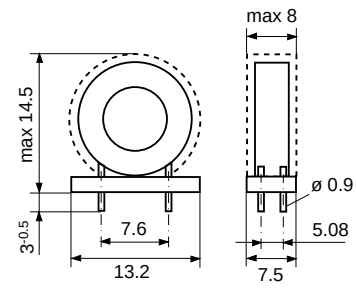

Fig. 11
Common mode choke LP 183, weight 7 g

12.1

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Mounting Supports for Chassis-, DIN-Rail- and PCB Mounting

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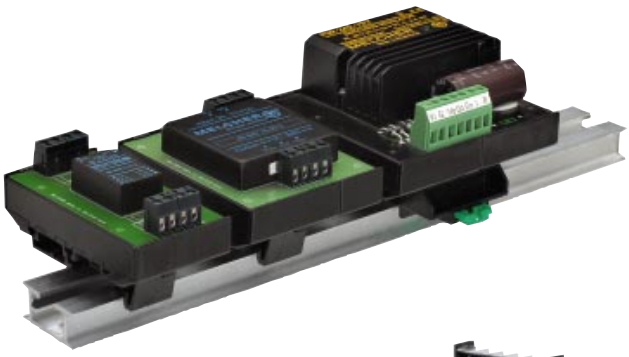


Description

Special mounting supports have been designed for the integration of Melcher power supplies into switch boards, control panels, printed circuit boards, etc. using adaptors for Chassis-, DIN-Rail or PCB mounting.

The 19 inch cassette type DC-DC and AC-DC converters can also be chassis mounted with frontal access by means of a special *Chassis Mounting Plate*, attached to the converters.

The *Universal Mounting Bracket* also fits to most of these cassette type converters, allowing for either vertical chassis- or DIN-Rail mounting.

A *Bracket Kit*, consisting of a PCB with screw terminal connectors and a bracket suitable for either Chassis- or DIN-Rail mounting, is available either for PCB mountable PSR and PSA Switching Regulators with option "Y" pins or for small DC-DC converters 1...15 W.

For isolation of the PCB-mountable converters from a double sided PCB, the use of *Isolation Pads* is recommended, as described below.

A *Flexible H11 PCB* allows for connection of casette type converters with H11 connector mounted on a printed circuit board to this board.

Note: All dimensions are in mm, with tolerances of ±0.2 mm unless otherwise specified.

Chassis Mounting Plates

For chassis mounting of 19" cassette type converters where only frontal access to the mounting screws is given, special chassis mounting plate adapters are available according to the following table and figures 1 to 3.

Table 1: Mounting Plate survey

Case size	Converter family	Part. No.	Delivery content
K02	K	Mounting plate K02	Mounting plate and 4 countersunk screws
S02	S		
Q01	Q	Mounting plate Q	
Q01	Q	Mounting plate M	Mounting plate, 4 countersunk screws and 4 washers
M02	M		
H02	H		

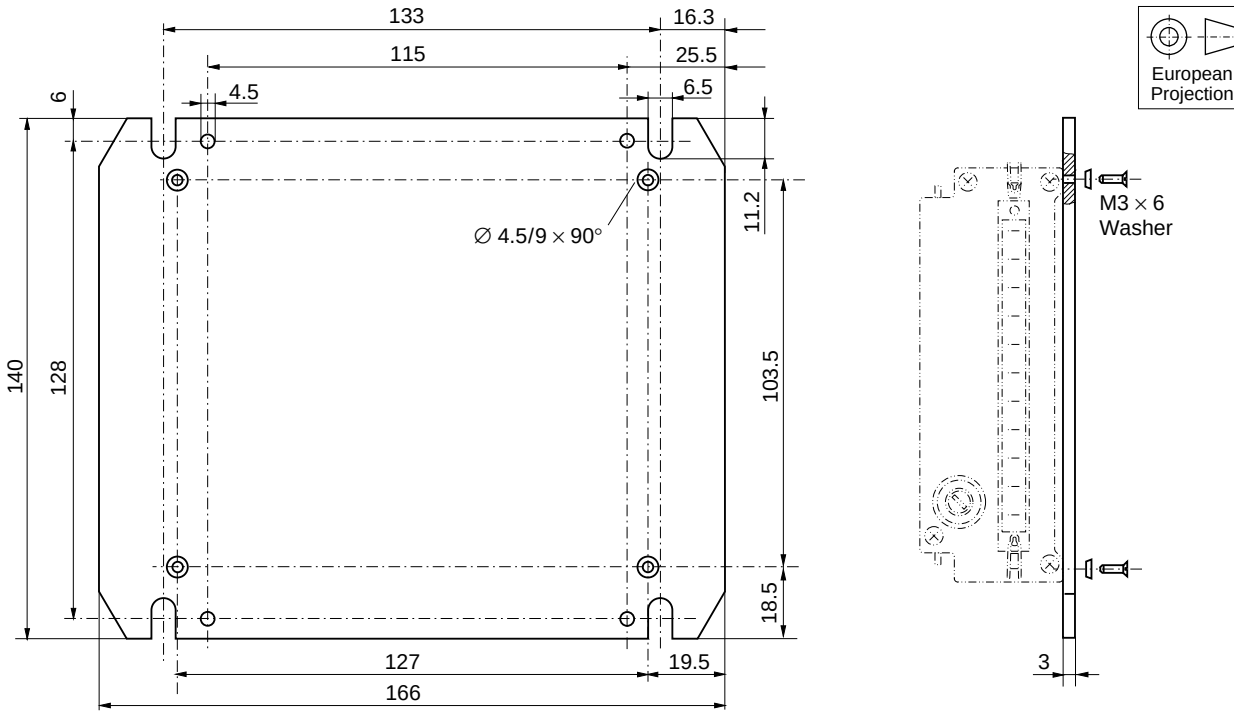


Fig. 1
Mounting plate M

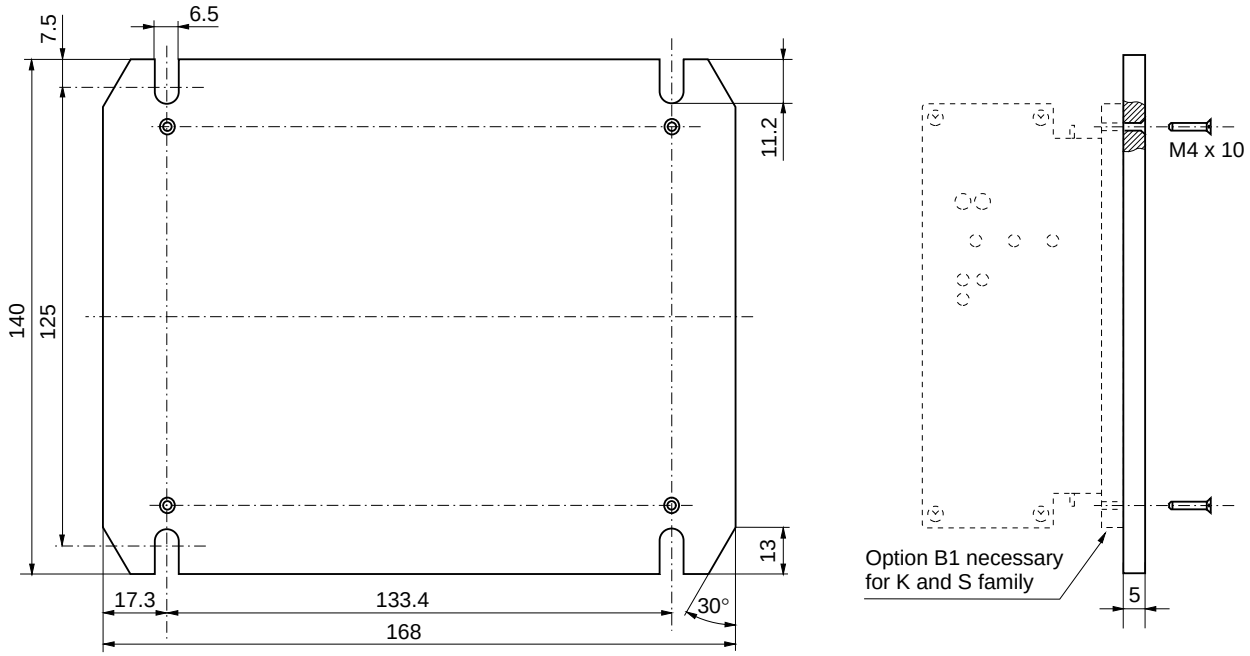


Fig. 2
Mounting plate K02

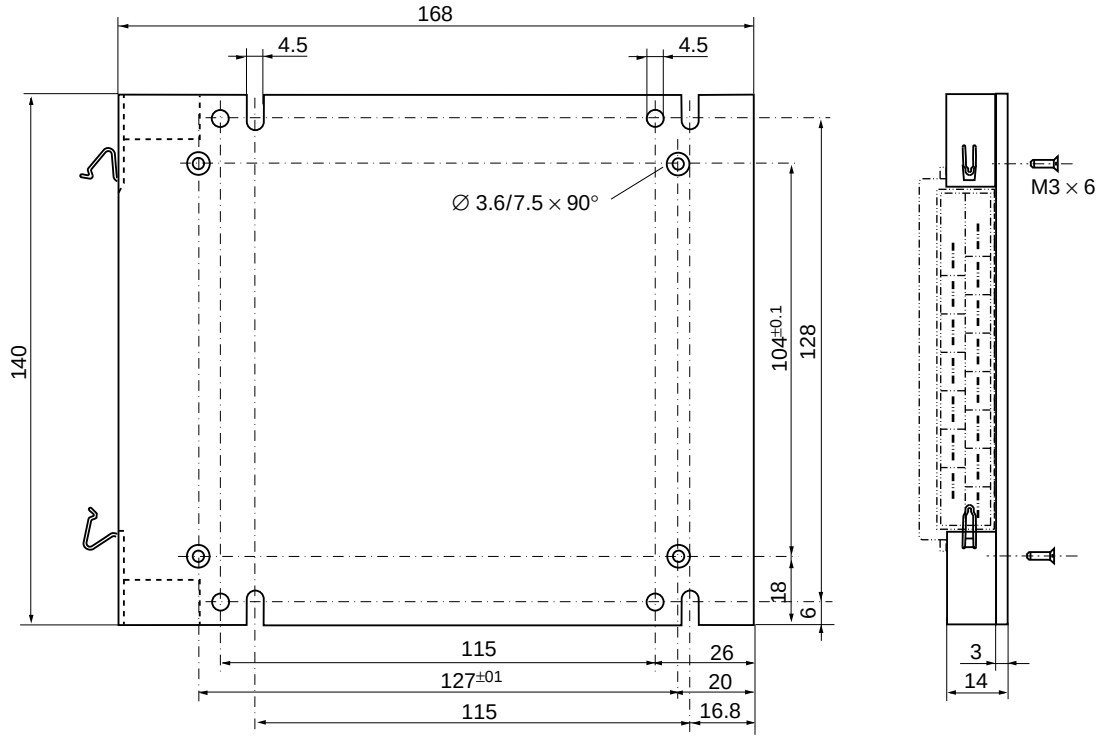


Fig. 3
Mounting plate Q with integrated connector retention facility

Note: Details on Connector Retention Clip V are given in section "Mating Connectors" of this chapter.

DIN- and Chassis Mounting Brackets

PCB mounting as well as cassette type converters can be chassis- and/or DIN-Rail mounted by means of Mounting Bracket adapters. For selection and part numbers refer to table 2.

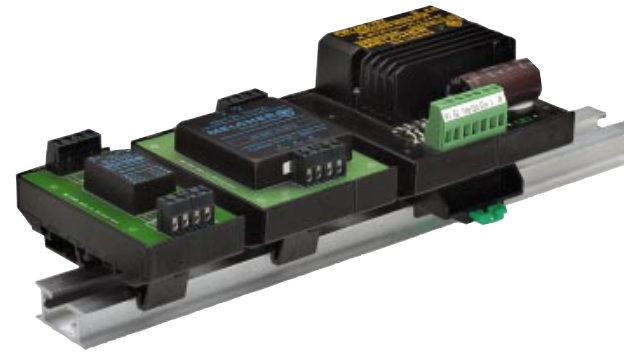


Table 2: Mounting Bracket survey

X [mm]	Y [mm]	Converter case size	Converter family	Part No. Chassis-mounting	Part No. DIN-mounting	Delivery content
95.0	90.0	A01	PSR	CMBA01-iRY/80	DMB A01-iRY/80	PCB, screw teminal blocks, 4 diodes, capacitor C1 and C- or D-bracket with screws
			PSA	CMBA01-iRY/144	DMB A01-iRY/144	
72.5	67.5	2"×2"	IBEK 6/10 Watt IMR 6...IMR 15 IMP 12	CMB2×2-BCFG	DMB 2×2-BCFG	PCB, screw teminal blocks, and C- or D-bracket
50.0	45.0	DIL 24	IBEK 3 Watt IPS 3 IMP 3	CMB3W-123	DMB 3W-123	

Each part number gives a direct indication of the kind of mounting, the type of converter, i.e. the case size or the output power as well as the possible pinnings and options according to the relevant converter data. The adaptors are divided into two mechanical types: *CMB* and *DMB*.

Note: Customized adapters for other case sizes are available upon request.

DMB: DIN-Rail Mounting Bracket

The DMB kit differs from the "CMB" version by a bracket suited for DIN-rail mounting (according to EN 50022, including Hat- and C-rail). The black plastic body of the bracket holds the PCB by means of a snap-in device. Four different versions according to table 2 are available.

Details on the layout of the PCB's and diagrams are given in the description below.

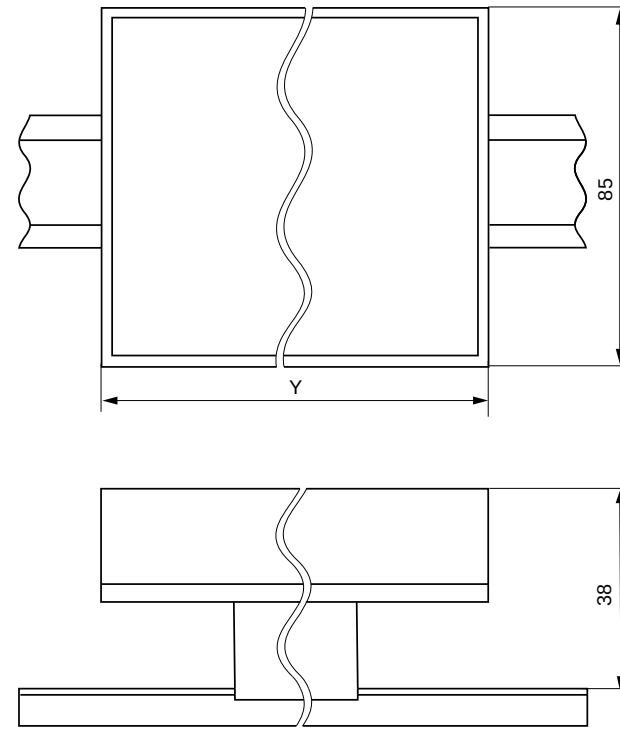


Fig. 4
"DMB" DIN-rail mounting bracket dimensions

12.1

CMB: Chassis Mounting Bracket

The kit consists of a PCB for the converter, a set of screw terminals allowing for easy electrical connection and two aluminium profiles, attached to the PCB by means of four screws, which serve as the chassis mounting bracket. Four different versions according to table 2 are available.

Details on the layout of the PCB's and diagrams are given in the description below.

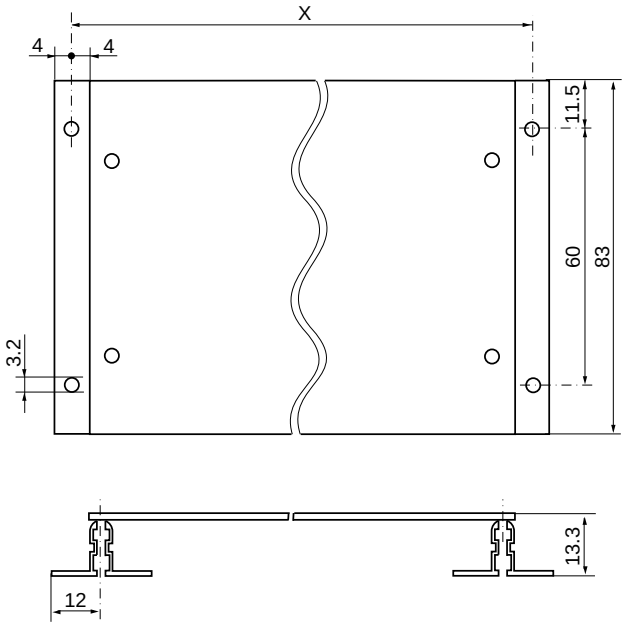


Fig. 5
"CMB" chassis mounting bracket dimensions

C/DMBA01- .. Electrical Description

This bracket is designed for non-isolated Melcher Switching Regulators of the PSR and PSA families in the A01 case size, equipped with "Option Y" pins and giving output voltages between 5 V and 48 V. Technical details, i.e. max. input voltage etc. are described in the relevant PSR and PSA data and further information is given in the application notes. The use of the optional inhibit- and R-functions (external output voltage adjustment with R1) is possible and the device can be driven either from a DC-source or from a transformer secondary voltage.

– DC-input: Consider the forward voltage drop across the rectifier diodes (also providing reverse polarity protection). Capacitor C1 compensates the negative converter input impedance in case of long connection wires to the module.

– AC-input: The recommended transformer secondary voltage is 48 V_{rms} for PSR and 72 V_{rms} for PSA.

Exception: Input voltage for PSR 54 (PSA 55) is 20 V_{rms}. PSR 54 (PSA 55) and PSR 362 require an additional capacitor (C2) of at least 470 µF.

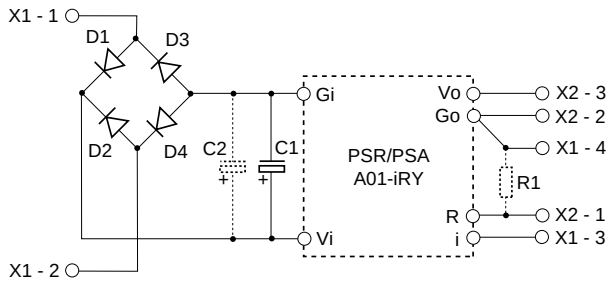


Fig. 6a
C/DMBA01- .. circuit diagram

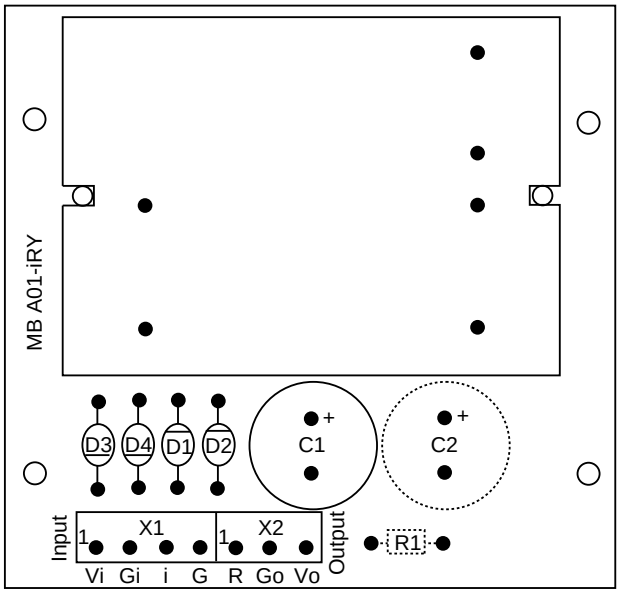


Fig. 6b
C/DMBA01- .. print layout

C/DMB2×2-BCFG Electrical Description

This bracket allows the mounting of isolated DC-DC converters of Melcher families IMR 6, IMR 15, IMP 12 and IBEK families IPS 10 (10 watt) and ICR 5 or ICR 6 (5/6 watt) in 2" by 2" cases with either one or two output voltages of 5, 12 or 15 V. The technical details are given in the relevant IMR 6, IMR 15, IMP 12 and IBEK 10 Watt or 6 Watt data.

Depending on the application input transient protection may be incorporated (e.g. an appropriately dimensioned Transzorb diode D1).

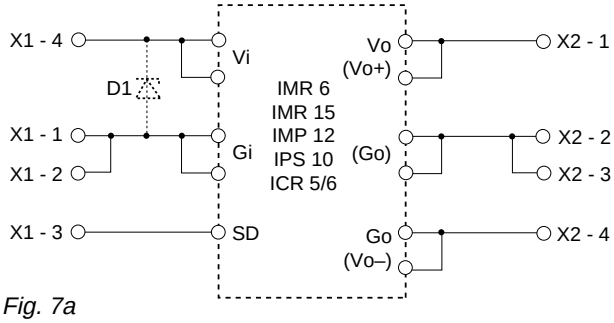


Fig. 7a
C/DMB2×2-BCFG circuit diagram

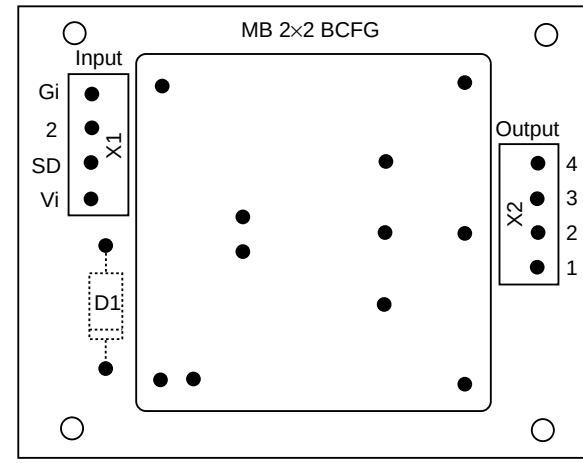


Fig. 7b
C/DMB2×2-BCFG print layout

C/DMB3W-123 Electrical Description

This bracket is designed for galvanically isolated DC-DC converters of the IMP 3, IBEK IPS 3 and IPW 3 families in DIL24 cases with one or two output voltages of 5, 12 or 15 V. The pin configuration of the converter groups 01, 02 and 03 and all technical converter details are described in the relevant data.

Depending on the application input transient protection may be incorporated (e.g. an appropriately dimensioned Transzorb diode D1) .

IPW 3 type converters require additional external coupling capacitors because of the increased isolation voltage (at least 220 pF/1 kV). They should be installed as follows:

– IPW 3 with group 01 pinning require capacitor C1 only
– IPW 3 with group 02 pinning require capacitor C2 only
– IPW 3 with group 03 pinning require both capacitor C2 and C3

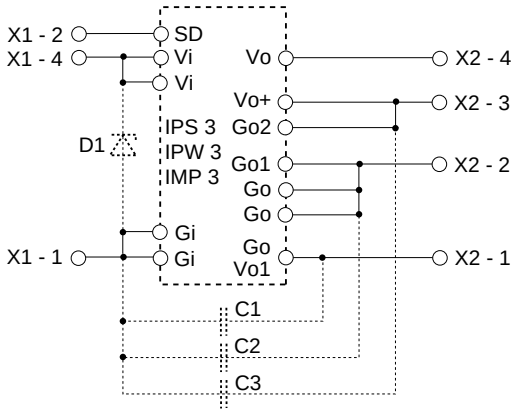


Fig. 8a
C/DMB3W-123 circuit diagram for all pin configurations

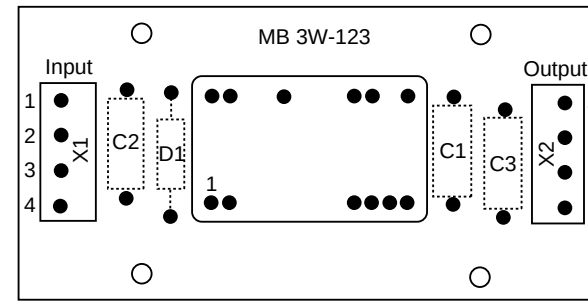


Fig. 8b
C/DMB3W-123 print layout

Universal Mounting Bracket for 19" Cassettes (DIN- and Chassis Mounting)

UMB-LHMQ

A special Universal Mounting Bracket has been designed for vertical or upright chassis- and DIN-Rail mounting of the 19" cassette type converters shown in table 3.

Table 3: Mounting Bracket survey

Converter case size	Converter family	Part No. Chassis-mounting	Part No. DIN-mounting	Delivery content
L01, L04 H02, M02 Q01	SR, PSL H, M Q	UMB-LHMQ	UMB-LHMQ	Alu-profile, two screws and a DIN-rail clamp with screw

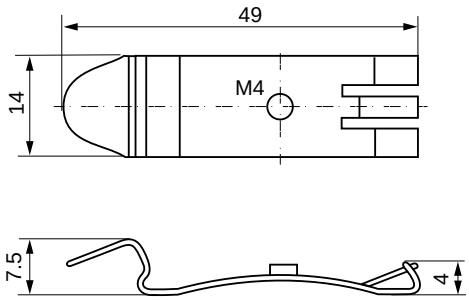


Fig. 9a
DIN-rail clamp

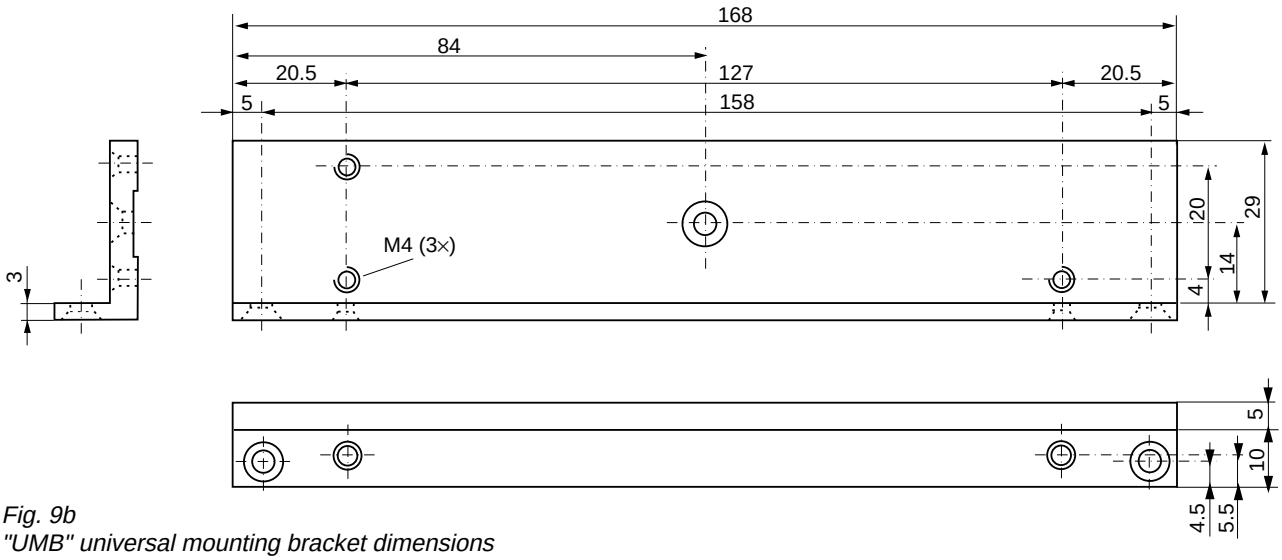


Fig. 9b
"UMB" universal mounting bracket dimensions

UMB-VERW ..

For VRW and VEW power supply modules two different mounting bracket types are available for DIN-rail mounting. The two mounting brackets are identical except the length of the support for the unit and the number and position of the holes for fixation of the unit to the mounting bracket.

Please refer to table 4 for selection of types.

Table 4: Mounting Bracket survey

Converter family	Part No. DIN-mounting	Delivery content
VRW 15 VRW 25 VEW 10 VEW 15	UMB-VERW 1	Complete mounting bracket without M3 screws
VRW 50 VEW 25	UMB-VERW 2	

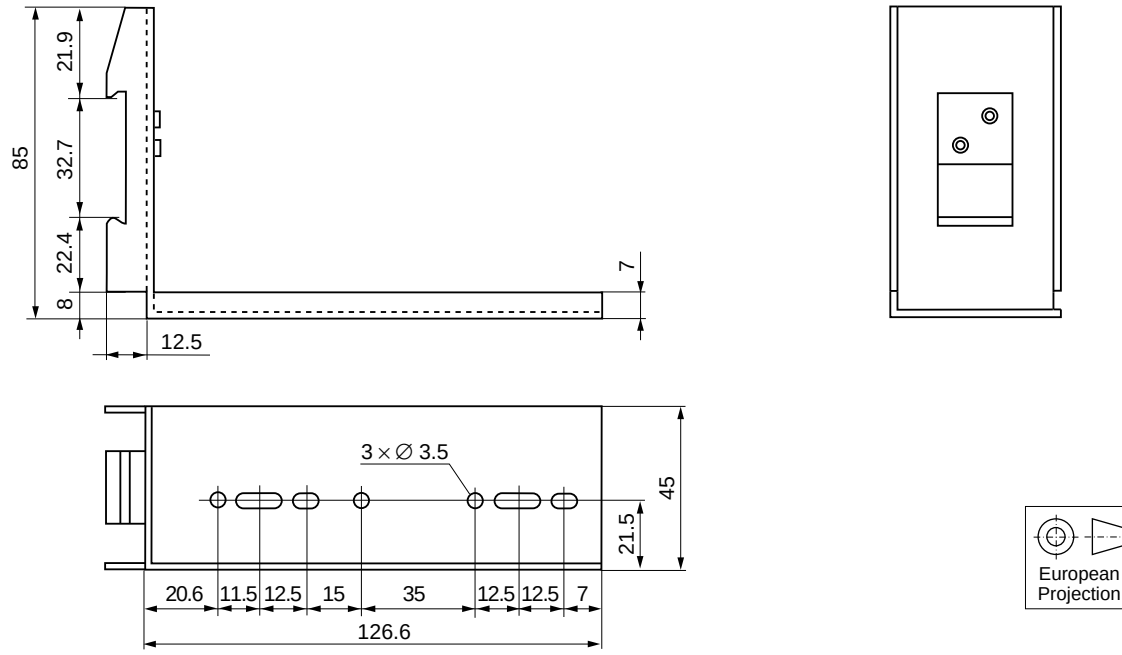


Fig. 10a
Mounting bracket UMB-VERW 1

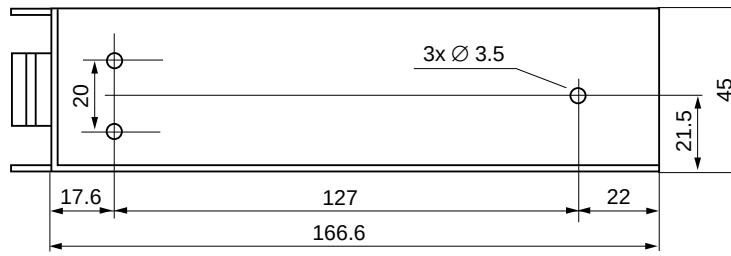


Fig. 10b
Mounting bracket UMB-VERW 2

Isolation Pads for PCB Mounting

In applications where PCB mounting converters are placed on top of double sided boards, the use of Isolation Pads is recommended. These fibre pads avoid short circuits and provide excellent protection against possible damage to tracks. For selection and part numbers refer to table 5:

Table 5: Isolation Pad survey

Case size	Converter family	Isolation pad Part. No.	Dimensions [mm]
A01	PSR, PSA	Isolation A	70 × 50 × 0.3
B02	PSB	Isolation B	107 × 71 × 0.3
C01	xSR 20	Isolation C	152 × 86 × 0.3
C03	PSC		
2"×2"	IMR 6/15 IBEK 6/10 W	Isolation 2"×2"	53 × 53 × 0.3
DIL24	IBEK 1 W IBEK 3 W	Isolation DIL24	33.8 × 21 × 0.3

PCB-Tags for PCB Mounting

DC-DC and AC-DC converters in C01 case and Switching Regulators either in B02 or C03 cases may also be mounted directly onto PCB's. The connection between the converters' fast-on pins and the PCB can be easily made by means of PCB-Tags as shown in figure 10.

Part No.: PCB Tag
Delivery content: 10 pieces

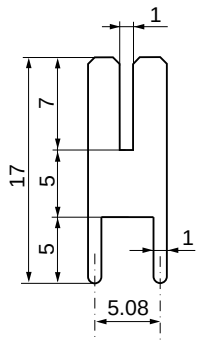
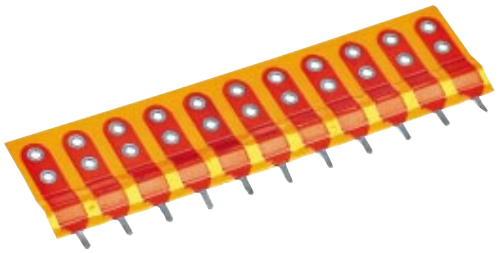


Fig. 11
PCB-Tag

Flexible H11 PCB

If cassette type converters with male H11 connectors (used for example in H- or M- Families) are mounted on wiring boards, the connection between the wiring board and the male converter connector may be made using the special H11 Flexi-PCB together with the female STV-H11-FB/CO connector (see also female connector data).

Part No: H11 Flexi-PCB



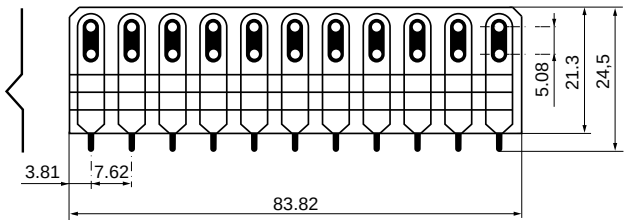


Fig. 12
H11 Flexi-PCB

Electronic Load

Mestro 300

Load capacity up to 300 W
Load input voltage up to 50 V
Load input current up to 20 A

- Selectable constant current or resistive load mode with two ranges
- Precise adjustment of load values by two 10-turn potentiometers
- 3½ digit load current display
- Internal pulse generator for dynamic load characteristic measurements
- Remote control
- Fully protected against overloads
- Parallel connection of several units possible

Table of Contents

Description

The electronic load Mestro 300 covers a wide range of applications in development laboratories, production monitoring, quality control, test facilities, goods inwards inspection, etc.

This unit is idealy suited for development and testing of power supply modules, generators, storage batteries, dry batteries, etc.

The wide setting range, high resolution and accuracy of the Mestro 300 allows the replacement of an entire bank of rheostats and simplifies test set-ups.

Moreover, the remote control feature allows for completely automated testing with different load values.

Operated in resistive mode, the Mestro 300 regulates the load current to a value which is proportional to the applied voltage.

Operated in constant current mode, the current drawn by the Mestro 300 is independent of the applied voltage. The static output deviation of a power supply module - due to load changes - can easily be determined by switching back and forth between two preset current values.

The dynamic behaviour of power supply modules as response to load changes can be tested by means of the built-in square wave pulse generator.

Any desired time dependent load variation can be set via the control input. Typical applications include the determination of the output impedance of a source versus frequency or storage battery testing with varying loads.

Electrical Data

General Condition: T_A = 25°C unless otherwise specified

Table 1: Load input characteristics

Characteristics		Range I min	Range I typ	Range I max	Range II min	Range II typ	Range II max	Unit
I_L	Load current control range	0		20	0		5.0	A DC
$I_{L\,max}$	Load current limit			22			5.5	
α_{IL}	Temperature drift		–4			–1		mA/K
$I_{L\,set}$	Resolution (manual setting)		3.2			0.8		mA
D_{set}	3 1/2 Digit LCD Display resolution (±1 digit)		±0.5			±0.5		%
R_L	Load resistance	0.16		1000	0.6		1000	Ω
U_L	Load voltage	1.75		50	1.75		50	V DC
$U_{L\,max}$	Overvoltage prot. (disconnection of load)		62			62		
$U_{i\,max}$	Overvoltage prot. (Crowbar triggering)		82			82		
P_{max}	Power rating (continuous)		300					W
P_{pulse}	Pulse rating (electronically limited)		Fig. 1					
$U_{L\,reverse}$	Reverse polarity protection		Reverse polarity diode					
U_{ctr}	Control input voltage range ($I_{L\,min}$...$I_{L\,max}$)	0		10	0		10	V
$U_{ctr\,max}$	Max. control input voltage (without damage)			100			100	V DC
R_{ctr}	Control resistance		External potentiometer					
f_{ctr}	Control input frequency (–3 dB)		40					kHz
Z_{ctr}	Control input impedance		250					kΩ
I_{pulse}	Individually adjustable	0		$I_{L\,max}$	0		$I_{L\,max}$	A
f_{pulse}	Pulse repetition frequency set by potentiometer	200		1800	200		1800	Hz
$t_{r,f}$	Rise/fall time 0.1...0.9 U_{pulse}		9					µs
T_{pulse}	Pulse duty cycle		50					%
U_{iso}	Isolation voltage: input to ground and control input to ground		±500					V DC

Mains Input Data

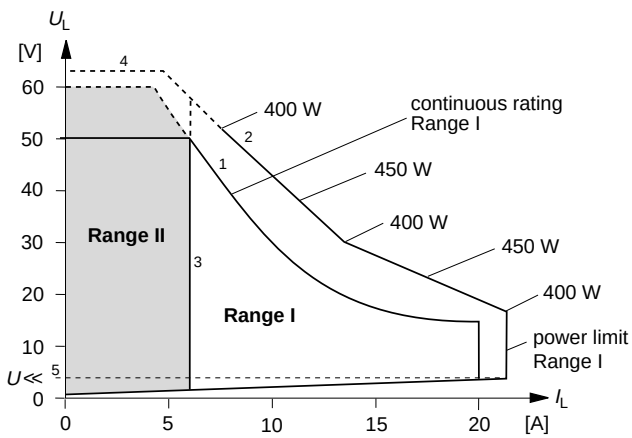
Mains voltage 230 V AC, 50…60 Hz, 25 VA,
Note:
Mains voltage 110 V AC, 50…60 Hz, 25 VA is available on request.

Safety

The Mestro 300 is a class I equipment according to IEC 950/EN 60950, i.e. a protective earth connection is provided.

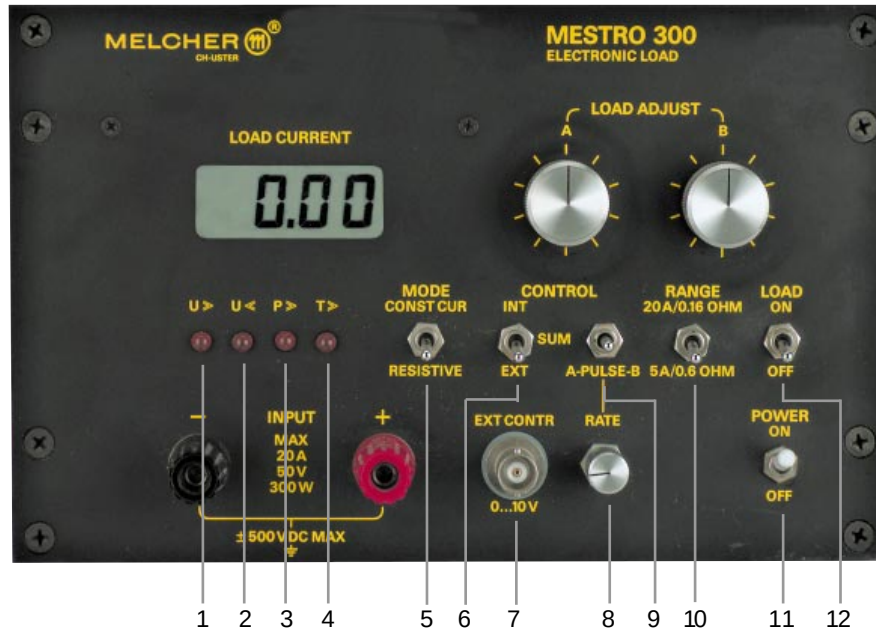
Environmental Conditions

Ambient temperature range: 0...40°C
Automatically controlled cooling fan built-in
Automatic disconnection of load at a heat sink temperature of approx. 80°C.



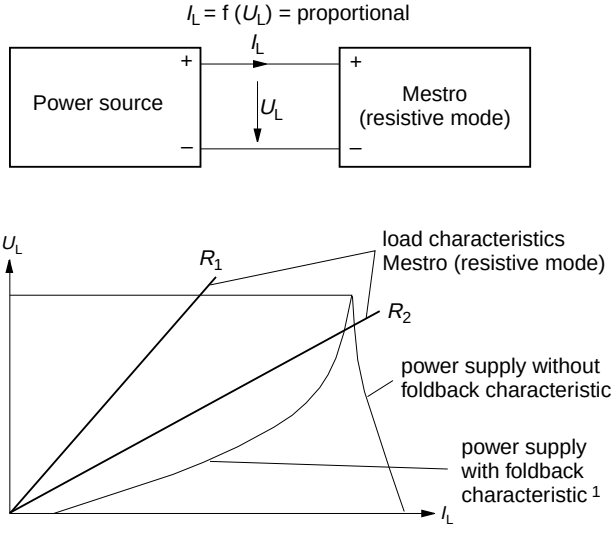
[1] Specified continuous rating (300 W) at T_A = 25°C
[2] Typical power limitation (Range I), indicated by the LED power limit (red)
[3] Typical current limitation (Range II), potentiometer adjusted to the upper limit
[4] Typical voltage limitation (upper limit), indicated by the red LED (≫U)
[5] Typical undervoltage condition (low limit), indicated by the red LED (U≪)

Fig. 1
Load ranges of Mestro 300



1 Overvoltage indicator
2 Undervoltage indicator
3 Overload indicator
4 Overtemperature indicator
5 Mode selector switch for constant current load or resistive load
6 Selector switch for internal or external control
7 BNC-connector for external control; not isolated from load circuit. A connected signal generator must be electrically isolated from the load circuit.
8 Switching rate between load A and load B
9 Triple-selector switch for potentiometer A, potentiometer B or pulse load. The minimum and maximum value of the pulse load can be preset independently by the two potentiometers.
10 Load range selector
11 Power switch
12 Load on/off

Resistive Load mode



1 With a Mestro 300 a power supply can be operated in this region. With a constant current load characteristic this would not be possible

Fig. 2
Resistive mode

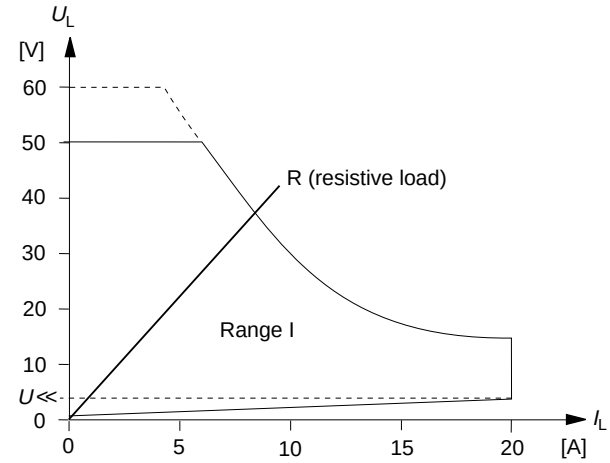


Fig. 3
Resistive mode

The Mestro behaves like a power rheostat but provides easier handling, better resolution, a wide setting range and a remote control input.

Constant Current Load mode (Current Sink)

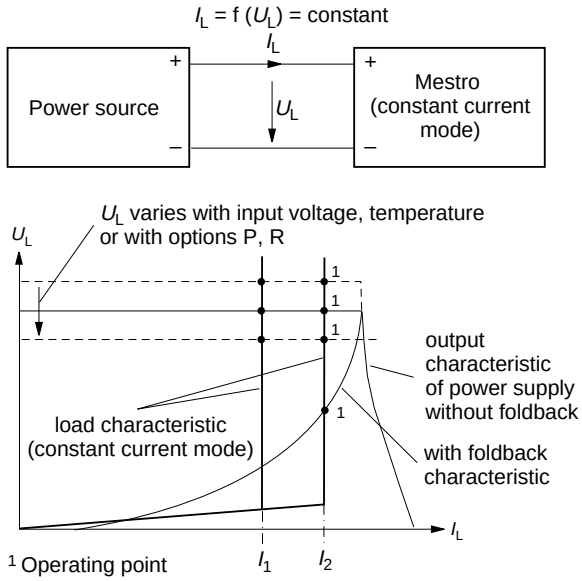


Fig. 4
Constant current mode

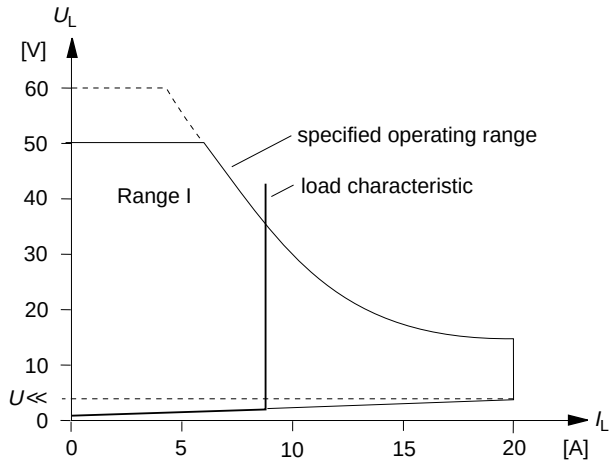


Fig. 5
Constant current load (current sink)

Constant Voltage Load (Voltage Sink)

Voltage sink consisting of a Mestro and a voltage source, basic set-up:

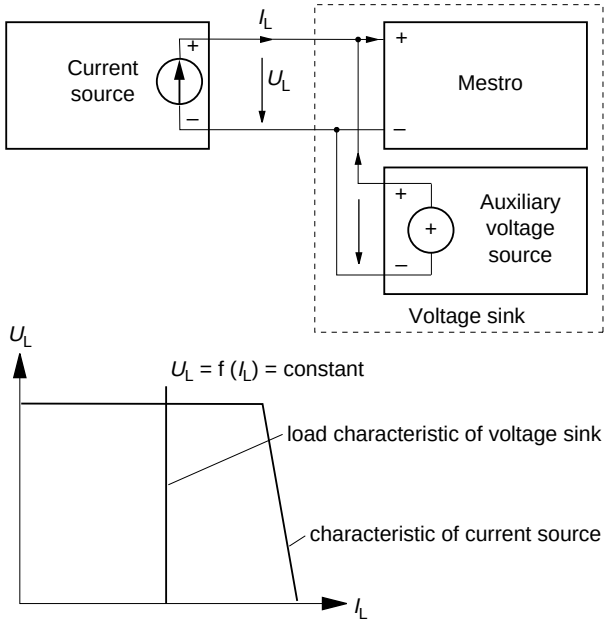
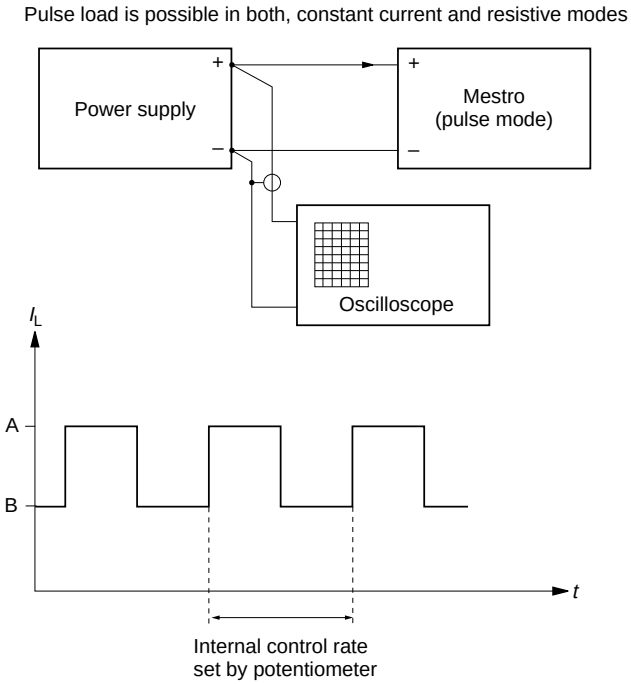


Fig. 6
Constant voltage mode

Pulse Mode Operation

Measuring the dynamic response of a power supply or testing the pulse load behaviour



A: Level set by potentiometer A
B: Level set by potentiometer B

Fig. 7
Pulse mode

Externally Controlled Load in Resistive Mode

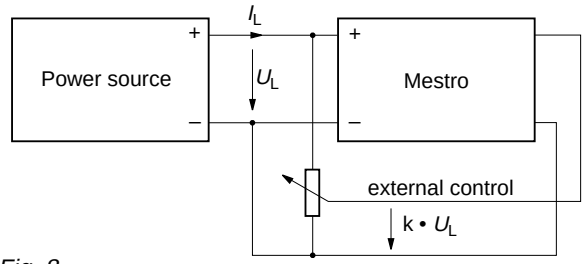


Fig. 8
External control of resistive load

$$I_L = U_{ctr} \bullet \frac{20\ A}{10\ V}\ , \qquad U_{ctr} = k \bullet U_L$$

$$I_L = U_L \bullet k \bullet \frac{20\ A}{10\ V}\ , \qquad R_L = I_L = \frac{10\ V}{k \bullet 20\ A} = \frac{1}{2 \bullet k}\ [\Omega]$$

k = 0…1, R_L = 0.5…∞ Ω

Remote Control:

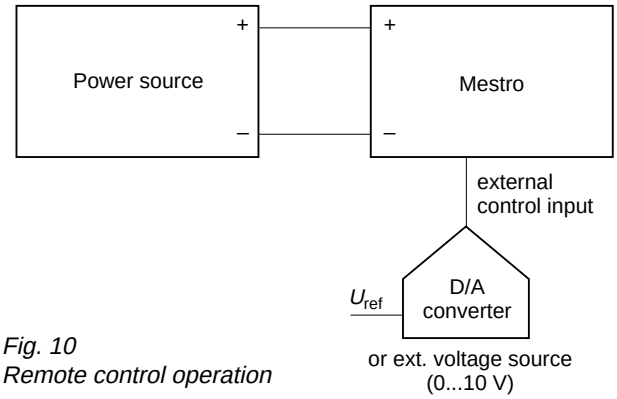


Fig. 10
Remote control operation

Time Varying Load

Remote control operating mode via control input:

In this mode, the 2 potentiometers, the constant current and/or resistive mode switch and the internal oscillator are not operating. (Only constant current mode operation.)

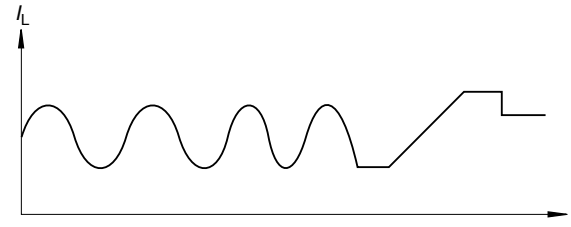


Fig. 9
Varying load versus time

Connection in Parallel

Several Mestros can be connected in parallel.

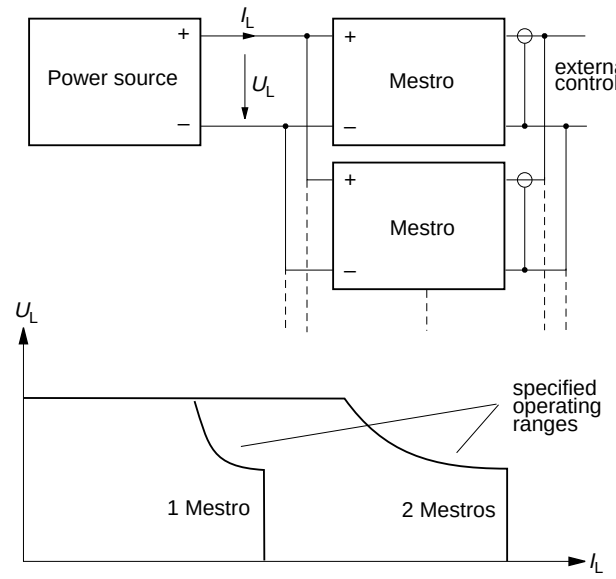


Fig. 11
Several Mestros connected in parallel

Connection in series is not permitted!

Mechanical Data

Case width: 214 m, case hight: 147 mm, case depth: 294 mm, overall depth: 318 mm

Weight: approx. 5 kg

Accessories

Assembly kit for installation of one or two Mestros into 19 inch 3 U rack systems (on request).

12.2

MELCHER The Power Partners.

Reply and Order Form

To: Melcher
(Please fax this form to your nearest Melcher office. The address and fax number can be found at the end of this chapter.)

From: Name: _____ Company: _____

Address: _____

Post Code: _____ Tel: _____ Fax: _____

Date: _____ Number of Pages: _____

Application: ☐ Transport ☐ Industry ☐ Telecom ☐ Instrumentation ☐ Other: _____

	1...10 W	11...50 W	51...150 W	151...500 W	>500 W
DC-DC Converters	☐	☐	☐	☐	☐
AC-DC Converters	☐	☐	☐	☐	☐
Switching Regulators	☐	☐	☐	☐	☐
Battery Chargers	☐	☐	☐	☐	☐
Miscellaneous	☐	☐	☐	☐	☐

☐ I have never heard of Melcher before
☐ I have used Melcher in the past
☐ I am currently using Melcher
☐ I am likely to use Melcher in the future

Remarks/Questions: _____

☐ Please register for future updates of the Melcher Data Book

☐ Please send me the content of the Data Book on a CD-ROM

☐ I have a request, please call

☐ Please send me a quotation for the following items:

☐ I order herewith the following items:

Type:	Options:	Quantity:	Req. Delivery:

Date: _____ Signature: _____

12.3

Inquiry Form for Customized Power Supply

Company: _____ Activity: _____

Name: _____ Function: _____

Departement: _____ Tel: _____ Fax: _____

Address: _____ Town: _____ Country: _____

Project/Application: _____

1. Required Electrical Data

1.1 Basic Type with closest Specs: _____

1.2 Input Voltage Range U_i: ☐ DC ☐ AC nom. _____ from _____ to _____ V

Line Frequency (AC mode): nom. _____ from _____ to _____ Hz

1.3 Nominal Output Voltage: $U_{o1\ nom}$ _____ $U_{o2\ nom}$ _____ $U_{o3\ nom}$ _____

1.4 Nominal Output Current: $I_{o1\ nom}$ _____ $I_{o2\ nom}$ _____ $I_{o3\ nom}$ _____

2. Environmental Conditions

2.1 Operating Ambient Temperature Range: from _____ to _____ °C

3. Mechanical Data

3.1 Type of Case: 19" Plug-in Cassette: Height: _____ U Width _____ TE

3.2 Print or Chassis Mount Module: Dimensions _____ mm

4. Commercial Information

4.1 Prototypes Requested by: Date _____ Quantity _____ Pcs.

4.2 Expected Quantity/Project Life Time: Quantity _____ Pcs./Year over _____ Year

4.3 Start of Series Production: Date _____ Quantity _____ Pcs.

4.4 Expected Price for Series Quantities: Price _____ Quantity _____ Pcs.

5. Other Data

5.1 Standards to Comply with: _____

5.2 Required Options/Features: _____

6. Appendices

☐ Yes _____ Pages ☐ No

Remarks

Date _____ Signature _____

Product Index: Stock Items

The following products and most accessories are available from stock and can be shipped to be all places in the world within 24 to 72 hours.

Remark "data sheet": Contact sales office for data sheet.

Type	Class	Category	Chapter
5 ICR 1-05-N	Rugged	DC-DC	6.1
5 ICR 1-15-N	Rugged	DC-DC	6.1
5 ICR 6-12-TC	Industrial	DC-DC	6.2
5 ICR 6-1212-TB	Industrial	DC-DC	6.2
5 ICR 6-1212-TC	Industrial	DC-DC	6.2
5 ICR 6-1515-TB	Industrial	DC-DC	6.2
5 ICR 6-1515-TC	Industrial	DC-DC	6.2
5 IMP 1-05-7	Industrial	DC-DC	data sheet
5 IMP 1-0505-7	Industrial	DC-DC	data sheet
5 IMP 1-12-7	Industrial	DC-DC	data sheet
5 IMP 1-1212-7	Industrial	DC-DC	data sheet
5 IMP 1-15-7	Industrial	DC-DC	data sheet
5 IMP 1-1515-7	Industrial	DC-DC	data sheet
5 IMP 5-05-7	Industrial	DC-DC	data sheet
5 IMP 5-0505-7	Industrial	DC-DC	data sheet
5 IMP 5-12-7	Industrial	DC-DC	data sheet
5 IMP 5-1212-7	Industrial	DC-DC	data sheet
5 IMP 5-15-7	Industrial	DC-DC	data sheet
5 IMP 5-1515-7	Industrial	DC-DC	data sheet
5 IWR 1-05-N	Rugged	DC-DC	6.1
5 IWR 1-0505-N	Rugged	DC-DC	6.1
5 IWR 1-12-N	Rugged	DC-DC	6.1
5 IWR 1-12-S	Rugged	DC-DC	6.1
5 IWR 1-1212-N	Rugged	DC-DC	6.1
5 IWR 1-1515-N	Rugged	DC-DC	6.1
12 CR 6-0505-6	Rugged	DC-DC	data sheet
12 CR 6-1212-6	Rugged	DC-DC	data sheet
12H1001-2R	Benign	DC-DC	7.3
12H1301-2R	Benign	DC-DC	7.3
12H1501-2R	Benign	DC-DC	7.3
12H1601-2R	Benign	DC-DC	7.3
12H1901-2R	Benign	DC-DC	7.3
12H2320-2	Benign	DC-DC	7.3
12H2540-2	Benign	DC-DC	7.3
12H3020-2	Benign	DC-DC	7.3
12H3040-2	Benign	DC-DC	7.3
12 ICR 6-12-TB	Industrial	DC-DC	6.2
12 ICR 6-1212-TB	Industrial	DC-DC	6.2
12 IMR 3-05-2	Benign	DC-DC	6.3
12 IMR 3-0505-2	Benign	DC-DC	6.3
12 IMR 3-12-2	Benign	DC-DC	6.3
12 IMR 3-1212-2	Benign	DC-DC	6.3
12 IMR 3-15-2	Benign	DC-DC	6.3
12 IMR 3-1515-2	Benign	DC-DC	6.3
12 IMR 6-05-2	Benign	DC-DC	6.3
12 IMR 6-0505-2	Benign	DC-DC	6.3
12 IMR 6-12-2	Benign	DC-DC	6.3
12 IMR 6-1212-2	Benign	DC-DC	6.3
12 IMR 6-15-2	Benign	DC-DC	6.3
12 IMR 6-1515-2	Benign	DC-DC	6.3
12 IMR 15-05-2	Benign	DC-DC	6.3
12 IMR 15-12-2	Benign	DC-DC	6.3
12 IMR 15-1212-2	Benign	DC-DC	6.3
12 IMR 15-15-2	Benign	DC-DC	6.3
12 IMR 15-1515-2	Benign	DC-DC	6.3
12 IWR 1-05-N	Rugged	DC-DC	6.1
12 IWR 1-05-S	Rugged	DC-DC	6.1
12 IWR 1-12-N	Rugged	DC-DC	6.1
12 IWR 1-1212-N	Rugged	DC-DC	6.1
19"/3U Rack	Rugged	Rack Sys.	2.2
20 IMX 7-03-7	Rugged	DC-DC	6.1
20 IMX 7-05-05-7	Rugged	DC-DC	6.1
20 IMX 7-05-7	Rugged	DC-DC	6.1
20 IMX 7-12-12-7	Rugged	DC-DC	6.1
20 IMX 7-15-15 7	Rugged	DC-DC	6.1
20 IMX 7-24-24-7	Rugged	DC-DC	6.1
24 CR 6-1205-6	Rugged	DC-DC	data sheet
24 CR 6-1212-6	Rugged	DC-DC	data sheet
24 CR 6-1515-6	Rugged	DC-DC	data sheet
24H1001-2R	Benign	DC-DC	7.3
24H1301-2R	Benign	DC-DC	7.3
24H1501-2R	Benign	DC-DC	7.3
24H1601-2R	Benign	DC-DC	7.3
24H1901-2R	Benign	DC-DC	7.3
24H2320-2	Benign	DC-DC	7.3
24H2540-2	Benign	DC-DC	7.3
24H3020-2	Benign	DC-DC	7.3
24H3040-2	Benign	DC-DC	7.3
24 ICR 5-05-TC	Industrial	DC-DC	6.2
24 ICR 6-1212-TC	Industrial	DC-DC	6.2
24 IMP 3-05-7	Industrial	DC-DC	6.2
24 IMP 3-0505-7	Industrial	DC-DC	6.2
24 IMP 3-05-05-7	Industrial	DC-DC	6.2
24 IMP 3-12-7	Industrial	DC-DC	6.2
24 IMP 3-1212-7	Industrial	DC-DC	6.2
24 IMP 3-12-12-7	Industrial	DC-DC	6.2
24 IMP 3-15-7	Industrial	DC-DC	6.2
24 IMP 3-1515-7	Industrial	DC-DC	6.2

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24 IMP 3-15-15-7	Industrial	DC-DC	6.2
24 IMP 12-05-7	Industrial	DC-DC	data sheet
24 IMP 12-0505-7	Industrial	DC-DC	data sheet
24 IMP 12-12-7	Industrial	DC-DC	data sheet
24 IMP 12-1212-7	Industrial	DC-DC	data sheet
24 IMP 12-15-7	Industrial	DC-DC	data sheet
24 IMP 12-1515-7	Industrial	DC-DC	data sheet
24 IMR 3-05-2	Benign	DC-DC	6.3
24 IMR 3-0505-2	Benign	DC-DC	6.3
24 IMR 3-12-2	Benign	DC-DC	6.3
24 IMR 3-1212-2	Benign	DC-DC	6.3
24 IMR 3-15-2	Benign	DC-DC	6.3
24 IMR 3-1515-2	Benign	DC-DC	6.3
24 IMR 6-05-2	Benign	DC-DC	6.3
24 IMR 6-0505-2	Benign	DC-DC	6.3
24 IMR 6-12-2	Benign	DC-DC	6.3
24 IMR 6-1212-2	Benign	DC-DC	6.3
24 IMR 6-15-2	Benign	DC-DC	6.3
24 IMR 6-1515-2	Benign	DC-DC	6.3
24 IMR 15-05-2	Benign	DC-DC	6.3
24 IMR 15-12-2	Benign	DC-DC	6.3
24 IMR 15-1212-2	Benign	DC-DC	6.3
24 IMR 15-15-2	Benign	DC-DC	6.3
24 IMR 15-1515-2	Benign	DC-DC	6.3
24 IMS 7-03-7	Industrial	DC-DC	6.2
24 IMS 7-05-7	Industrial	DC-DC	6.2
24 IMS 7-05-05-7	Industrial	DC-DC	6.2
24 IMS 7-12-12-7	Industrial	DC-DC	6.2
24 IMS 7-15-15-7	Industrial	DC-DC	6.2
24 IMS 7-24-24-7	Industrial	DC-DC	6.2
24 IPS 3-05-T	Rugged	DC-DC	6.1
24 IPS 3-0505-T	Rugged	DC-DC	6.1
24 IPS 3-05-05-T	Rugged	DC-DC	6.1
24 IPS 3-05-12-T	Rugged	DC-DC	6.1
24 IPS 3-12-T	Rugged	DC-DC	6.1
24 IPS 3-1212-T	Rugged	DC-DC	6.1
24 IPS 3-15-T	Rugged	DC-DC	6.1
24 IPS 3-1515-T	Rugged	DC-DC	6.1
24 IPS 10-05-TC	Rugged	DC-DC	6.1
24 IPS 10-0505-TC	Rugged	DC-DC	6.1
24 IPS 10-12-TC	Rugged	DC-DC	6.1
24 IPS 10-1212-TC	Rugged	DC-DC	6.1
24 IPS 10-15-TC	Rugged	DC-DC	6.1
24 IPS 10-1515-TC	Rugged	DC-DC	6.1
24 IWR 1-05-N	Rugged	DC-DC	6.1
24 IWR 1-05-05-N	Rugged	DC-DC	6.1
24 IWR 1-12-N	Rugged	DC-DC	6.1
24 IWR 1-1212-N	Rugged	DC-DC	6.1
24 IWR 1-1515-N	Rugged	DC-DC	6.1
24 IWR 1-15-15-N	Rugged	DC-DC	6.1

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24Q1001-2R	Benign	DC-DC	7.3
24Q2320-2R	Benign	DC-DC	7.3
24Q2540-2R	Benign	DC-DC	7.3
24Q2660-2R	Benign	DC-DC	7.3
24 TVG-05-FA	Rugged	DC-AC	data sheet
24 TVG-06-W	Rugged	DC-AC	data sheet
36 TVG-05-FA	Rugged	DC-AC	data sheet
40 IMR 3-05-2	Benign	DC-DC	6.3
40 IMR 3-0505-2	Benign	DC-DC	6.3
40 IMR 3-12-2	Benign	DC-DC	6.3
40 IMR 3-1212-2	Benign	DC-DC	6.3
40 IMR 3-15-2	Benign	DC-DC	6.3
40 IMR 3-1515-2	Benign	DC-DC	6.3
40 IMR 6-05-2	Benign	DC-DC	6.3
40 IMR 6-0505-2	Benign	DC-DC	6.3
40 IMR 6-12-2	Benign	DC-DC	6.3
40 IMR 6-1212-2	Benign	DC-DC	6.3
40 IMR 6-15-2	Benign	DC-DC	6.3
40 IMR 6-1515-2	Benign	DC-DC	6.3
40 IMX 7-03-7	Rugged	DC-DC	6.1
40 IMX 7-05-7	Rugged	DC-DC	6.1
40 IMX 7-05-05-7	Rugged	DC-DC	6.1
40 IMX 7-12-12-7	Rugged	DC-DC	6.1
40 IMX 7-15-15 7	Rugged	DC-DC	6.1
40 IMX 7-24-24-7	Rugged	DC-DC	6.1
48H1001-2R	Benign	DC-DC	7.3
48H1301-2R	Benign	DC-DC	7.3
48H1501-2R	Benign	DC-DC	7.3
48H1601-2R	Benign	DC-DC	7.3
48H1901-2R	Benign	DC-DC	7.3
48H2320-2	Benign	DC-DC	7.3
48H2540-2	Benign	DC-DC	7.3
48H3020-2	Benign	DC-DC	7.3
48H3040-2	Benign	DC-DC	7.3
48 ICR 1-05-N	Rugged	DC-DC	6.1
48 IMP 3-05-7	Industrial	DC-DC	6.2
48 IMP 3-0505-7	Industrial	DC-DC	6.2
48 IMP 3-05-05-7	Industrial	DC-DC	6.2
48 IMP 3-12-7	Industrial	DC-DC	6.2
48 IMP 3-1212-7	Industrial	DC-DC	6.2
48 IMP 3-12-12-7	Industrial	DC-DC	6.2
48 IMP 3-15-7	Industrial	DC-DC	6.2
48 IMP 3-1515-7	Industrial	DC-DC	6.2
48 IMP 3-15-15-7	Industrial	DC-DC	6.2
48 IMP 12-05-7	Industrial	DC-DC	data sheet
48 IMP 12-0505-7	Industrial	DC-DC	data sheet
48 IMP 12-12-7	Industrial	DC-DC	data sheet
48 IMP 12-1212-7	Industrial	DC-DC	data sheet
48 IMP 12-15-7	Industrial	DC-DC	data sheet
48 IMP 12-1515-7	Industrial	DC-DC	data sheet

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48 IMR 3-05-2	Benign	DC-DC	6.3
48 IMR 3-0505-2	Benign	DC-DC	6.3
48 IMR 3-12-2	Benign	DC-DC	6.3
48 IMR 3-1212-2	Benign	DC-DC	6.3
48 IMR 3-15-2	Benign	DC-DC	6.3
48 IMR 3-1515-2	Benign	DC-DC	6.3
48 IMR 6-05-2	Benign	DC-DC	6.3
48 IMR 6-0505-2	Benign	DC-DC	6.3
48 IMR 6-12-2	Benign	DC-DC	6.3
48 IMR 6-1212-2	Benign	DC-DC	6.3
48 IMR 6-15-2	Benign	DC-DC	6.3
48 IMR 6-1515-2	Benign	DC-DC	6.3
48 IMR 15-05-2	Benign	DC-DC	6.3
48 IMR 15-12-2	Benign	DC-DC	6.3
48 IMR 15-1212-2	Benign	DC-DC	6.3
48 IMR 15-15-2	Benign	DC-DC	6.3
48 IMR 15-1515-2	Benign	DC-DC	6.3
48 IMS 7-03-7	Industrial	DC-DC	6.2
48 IMS 7-05-7	Industrial	DC-DC	6.2
48 IMS 7-05-05-7	Industrial	DC-DC	6.2
48 IMS 7-12-12-7	Industrial	DC-DC	6.2
48 IMS 7-15-15-7	Industrial	DC-DC	6.2
48 IMS 7-24-24-7	Industrial	DC-DC	6.2
48 IPS 3-05-T	Rugged	DC-DC	6.1
48 IPS 3-0505-T	Rugged	DC-DC	6.1
48 IPS 3-05-05-T	Rugged	DC-DC	6.1
48 IPS 3-05-12-T	Rugged	DC-DC	6.1
48 IPS 3-12-T	Rugged	DC-DC	6.1
48 IPS 3-1212-T	Rugged	DC-DC	6.1
48 IPS 3-15-T	Rugged	DC-DC	6.1
48 IPS 3-1515-T	Rugged	DC-DC	6.1
48 IPS 10-05-TC	Rugged	DC-DC	6.1
48 IPS 10-0505-TC	Rugged	DC-DC	6.1
48 IPS 10-12-TC	Rugged	DC-DC	6.1
48 IPS 10-1212-TC	Rugged	DC-DC	6.1
48 IPS 10-15-TC	Rugged	DC-DC	6.1
48 IPS 10-1515-TC	Rugged	DC-DC	6.1
48 IWR 1-05-N	Rugged	DC-DC	6.1
48Q1001-2R	Benign	DC-DC	7.3
48Q2320-2R	Benign	DC-DC	7.3
48Q2540-2R	Benign	DC-DC	7.3
48Q2660-2R	Benign	DC-DC	7.3
70 IMX 7-03-7	Ruged	DC-DC	6.1
70 IMX 7-05-7	Ruged	DC-DC	6.1
70 IMX 7-05-05-7	Ruged	DC-DC	6.1
70 IMX 7-12-12-7	Ruged	DC-DC	6.1
70 IMX 7-15-15-7	Ruged	DC-DC	6.1
70 IMX 7-24-24-7	Ruged	DC-DC	6.1
110H1001-2R	Benign	AC-DC	10.3
110H1301-2R	Benign	AC-DC	10.3
110H1501-2R	Benign	AC-DC	10.3
110H1601-2R	Benign	AC-DC	10.3
110H1901-2R	Benign	AC-DC	10.3
110H2320-2	Benign	AC-DC	10.3
110H2540-2	Benign	AC-DC	10.3
110H3020-2	Benign	AC-DC	10.3
110H3040-2	Benign	AC-DC	10.3
110 TVG-05-FA	Rugged	DC-AC	data sheet
110 TVG-06-W	Rugged	DC-AC	data sheet
230H1001-2R	Benign	AC-DC	10.3
230H1301-2R	Benign	AC-DC	10.3
230H1501-2R	Benign	AC-DC	10.3
230H1601-2R	Benign	AC-DC	10.3
230H1901-2R	Benign	AC-DC	10.3
230H2320-2	Benign	AC-DC	10.3
230H2540-2	Benign	AC-DC	10.3
230H3020-2	Benign	AC-DC	10.3
230H3040-2	Benign	AC-DC	10.3
AK 1001-7R	Rugged	DC-DC	8.1
AK 1301-7R	Rugged	DC-DC	8.1
AK 1501-7R	Rugged	DC-DC	8.1
AK 1601-7R	Rugged	DC-DC	8.1
AK 2320-7R	Rugged	DC-DC	8.1
AK 2540-7R	Rugged	DC-DC	8.1
AK 2660-7R	Rugged	DC-DC	8.1
AM 1001-7R	Rugged	DC-DC	7.1
AM 1301-7R	Rugged	DC-DC	7.1
AM 1501-7R	Rugged	DC-DC	7.1
AM 1601-7R	Rugged	DC-DC	7.1
AM 2320-7	Rugged	DC-DC	7.1
AM 2320-9	Rugged	DC-DC	7.1
AM 2540-7	Rugged	DC-DC	7.1
AM 3020-7	Rugged	DC-DC	7.1
AM 3040-7	Rugged	DC-DC	7.1
AS 1001-7R	Rugged	DC-DC	7.1
AS 1301-7R	Rugged	DC-DC	7.1
AS 1501-7R	Rugged	DC-DC	7.1
AS 1601-7R	Rugged	DC-DC	7.1
AS 2320-7R	Rugged	DC-DC	7.1
AS 2540-7R	Rugged	DC-DC	7.1
AS 2660-7R	Rugged	DC-DC	7.1
BK 1001-7R	Rugged	DC-DC	8.1
BK 1301-7R	Rugged	DC-DC	8.1
BK 1501-7R	Rugged	DC-DC	8.1
BK 1601-7R	Rugged	DC-DC	8.1
BK 2320-7R	Rugged	DC-DC	8.1
BK 2540-7R	Rugged	DC-DC	8.1
BK 2660-7R	Rugged	DC-DC	8.1
BM 1001-7R	Rugged	DC-DC	7.1
BM 1301-7R	Rugged	DC-DC	7.1

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BM 1501-7R	Rugged	DC-DC	7.1
BM 1601-7R	Rugged	DC-DC	7.1
BM 2320-7	Rugged	DC-DC	7.1
BM 2540-7	Rugged	DC-DC	7.1
BM 3020-7	Rugged	DC-DC	7.1
BM 3040-7	Rugged	DC-DC	7.1
BPD 1002	Rugged	Back Plane	2.2
BPF 1007	Rugged	Back Plane	2.2
BQ 1001-7R	Industrial	DC-DC	8.2
BQ 2320-7R	Industrial	DC-DC	8.2
BQ 2540-7R	Industrial	DC-DC	8.2
BQ 2660-7R	Industrial	DC-DC	8.2
BS 1001-7R	Rugged	DC-DC	7.1
BS 1301-7R	Rugged	DC-DC	7.1
BS 1501-7R	Rugged	DC-DC	7.1
BS 1601-7R	Rugged	DC-DC	7.1
BS 2320-7R	Rugged	DC-DC	7.1
BS 2540-7R	Rugged	DC-DC	7.1
BS 2660-7R	Rugged	DC-DC	7.1
BSR 2005-7iP	Industrial	DC-DC	6.2
BSR 2005-7R	Industrial	DC-DC	6.2
BSR 2005E -7	Rugged	DC-DC	data sheet
BSR 2012-7	Industrial	DC-DC	6.2
BSR 2012E -7	Industrial	DC-DC	data sheet
BSR 2015-7	Industrial	DC-DC	6.2
BSR 2024-7	Industrial	DC-DC	6.2
BSR 2024E -7	Industrial	DC-DC	data sheet
BSR 3005-7R	Rugged	DC-DC	data sheet
BSR 3005-9RP	Industrial	DC-DC	data sheet
BSR 3012-7	Industrial	DC-DC	data sheet
CK 1001-7R	Rugged	DC-DC	8.1
CK 1301-7R	Rugged	DC-DC	8.1
CK 1501-7R	Rugged	DC-DC	8.1
CK 1601-7R	Rugged	DC-DC	8.1
CK 2320-7R	Rugged	DC-DC	8.1
CK 2540-7R	Rugged	DC-DC	8.1
CK 2660-7R	Rugged	DC-DC	8.1
CM 1001-7R	Rugged	DC-DC	7.1
CM 1301-7R	Rugged	DC-DC	7.1
CM 1501-7R	Rugged	DC-DC	7.1
CM 1601-7R	Rugged	DC-DC	7.1
CM 1901-7R	Rugged	DC-DC	7.1
CM 2320-7	Rugged	DC-DC	7.1
CM 2540-7	Rugged	DC-DC	7.1
CM 3020-7	Rugged	DC-DC	7.1
CM 3040-7	Rugged	DC-DC	7.1
CMZ 1001-7R	Rugged	DC-DC	7.1
CMZ 3020-7	Rugged	DC-DC	7.1
CQ 1001-7R	Industrial	DC-DC	8.2
CQ 2320-7R	Industrial	DC-DC	8.2
CQ 2540-7R	Industrial	DC-DC	8.2
CQ 2660-7R	Industrial	DC-DC	8.2
CS 1001-7R	Rugged	DC-DC	7.1
CS 1301-7R	Rugged	DC-DC	7.1
CS 1501-7R	Rugged	DC-DC	7.1
CS 1601-7R	Rugged	DC-DC	7.1
CS 2320-7R	Rugged	DC-DC	7.1
CS 2540-7R	Rugged	DC-DC	7.1
CS 2660-7R	Rugged	DC-DC	7.1
CSR 2005-7iP	Industrial	DC-DC	6.2
CSR 2005E -7	Industrial	DC-DC	data sheet
CSR 2012-7	Industrial	DC-DC	6.2
CSR 2012E -7	Industrial	DC-DC	data sheet
CSR 2024-7	Industrial	DC-DC	6.2
CSR 2024E -7	Industrial	DC-DC	data sheet
CSR 3005-7P	Industrial	DC-DC	data sheet
DK 1001-7R	Rugged	DC-DC	8.1
DK 1301-7R	Rugged	DC-DC	8.1
DK 1501-7R	Rugged	DC-DC	8.1
DK 1601-7R	Rugged	DC-DC	8.1
DK 2320-7R	Rugged	DC-DC	8.1
DK 2540-7R	Rugged	DC-DC	8.1
DK 2660-7R	Rugged	DC-DC	8.1
DM 1001-7R	Rugged	DC-DC	7.1
DM 1301-7R	Rugged	DC-DC	7.1
DM 1501-7R	Rugged	DC-DC	7.1
DM 1601-7R	Rugged	DC-DC	7.1
DM 2320-7	Rugged	DC-DC	7.1
DM 2540-7	Rugged	DC-DC	7.1
DM 3020-7	Rugged	DC-DC	7.1
DM 3040-7	Rugged	DC-DC	7.1
DQ 1001-7R	Industrial	DC-DC	8.2
DQ 2320-7R	Industrial	DC-DC	8.2
DQ 2540-7R	Industrial	DC-DC	8.2
DQ 2660-7R	Industrial	DC-DC	8.2
DS 1001-7R	Rugged	DC-DC	7.1
DS 1301-7R	Rugged	DC-DC	7.1
DS 1501-7R	Rugged	DC-DC	7.1
DS 1601-7R	Rugged	DC-DC	7.1
DS 2540-7R	Rugged	DC-DC	7.1
DS 2660-7R	Rugged	DC-DC	7.1
DSR 2005-7	Industrial	DC-DC	6.2
DSR 2024-7iP	Industrial	DC-DC	6.2
EQ 1001-7R	Industrial	DC-DC	8.2
EQ 2320-7R	Industrial	DC-DC	8.2
EQ 2540-7R	Industrial	DC-DC	8.2
EQ 2660-7R	Industrial	DC-DC	8.2
FCR 6-1205-6	Rugged	DC-DC	data sheet
FCR 6-1212-6	Rugged	DC-DC	data sheet
FCR 6-1515-6	Rugged	DC-DC	data sheet

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FDB 1001M	Benign	Regulator	4.3
FDB 1001S	Benign	Regulator	4.3
FDB 1002M	Benign	Regulator	4.3
FDB 1002S	Benign	Regulator	4.3
FDB 2001M	Benign	Regulator	4.3
FDB 2001S	Benign	Regulator	4.3
FDB 2002M	Benign	Regulator	4.3
FDB 2002S	Benign	Regulator	4.3
FDD 1106M	Benign	Regulator	4.3
FDD 1106S	Benign	Regulator	4.3
FDD 1203M	Benign	Regulator	4.3
FDD 1203S	Benign	Regulator	4.3
FDF 1103M	Benign	Regulator	4.3
FDF 1103S	Benign	Regulator	4.3
FI 05F015-1	Benign	Regulator	6.3
FI 05F030-1	Benign	Regulator	6.3
FI 12D015-1	Benign	Regulator	6.3
FI 12D030-1	Benign	Regulator	6.3
FI 12F015-1	Benign	Regulator	6.3
FI 12F030-1	Benign	Regulator	6.3
FI 15D015-1	Benign	Regulator	6.3
FI 15D030-1	Benign	Regulator	6.3
FI 15F015-1	Benign	Regulator	6.3
FI 15F030-1	Benign	Regulator	6.3
FK 1001-7R	Rugged	DC-DC	8.1
FK 1001-9R	Rugged	DC-DC	8.1
FK 1301-7R	Rugged	DC-DC	8.1
FK 1301-9R	Rugged	DC-DC	8.1
FK 1501-7R	Rugged	DC-DC	8.1
FK 1501-9R	Rugged	DC-DC	8.1
FK 1601-7R	Rugged	DC-DC	8.1
FK 1601-9R	Rugged	DC-DC	8.1
FK 2320-7R	Rugged	DC-DC	8.1
FK 2320-9R	Rugged	DC-DC	8.1
FK 2540-7R	Rugged	DC-DC	8.1
FK 2540-9R	Rugged	DC-DC	8.1
FK 2660-7R	Rugged	DC-DC	8.1
FK 2660-9R	Rugged	DC-DC	8.1
FM 1001-7R	Rugged	DC-DC	7.1
FM 1301-7R	Rugged	DC-DC	7.1
FM 1601-7R	Rugged	DC-DC	7.1
FM 1901-7R	Rugged	DC-DC	7.1
FM 2540-7	Rugged	DC-DC	7.1
FN 05P030-0	Benign	Regulator	4.3
FN 12D015-1	Benign	Regulator	4.3
FN 12D030-1	Benign	Regulator	4.3
FN 12P030-1	Benign	Regulator	4.3
FN 15D015-1	Benign	Regulator	4.3
FN 15D030-1	Benign	Regulator	4.3
FN 15P030-1	Benign	Regulator	4.3

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FS 1001-7R	Rugged	DC-DC	7.1
FS 1301-7R	Rugged	DC-DC	7.1
FS 1501-7R	Rugged	DC-DC	7.1
FS 1601-7R	Rugged	DC-DC	7.1
FS 2540-7R	Rugged	DC-DC	7.1
FS 2660-7R	Rugged	DC-DC	7.1
GQ 1001-7R	Industrial	DC-DC	8.2
GQ 2320-7R	Industrial	DC-DC	8.2
GQ 2540-7R	Industrial	DC-DC	8.2
GQ 2660-7R	Industrial	DC-DC	8.2
HK 300-05	Benign	AC-DC	11.3
HK 300-24	Benign	AC-DC	11.3
LK 1001-7ER	Rugged	AC-DC	11.1
LK 1001-7R	Rugged	AC-DC	11.1
LK 1301-7R	Rugged	AC-DC	11.1
LK 1501-7R	Rugged	AC-DC	11.1
LK 1601-7R	Rugged	AC-DC	11.1
LK 2320-7R	Rugged	AC-DC	11.1
LK 2540-7R	Rugged	AC-DC	11.1
LK 2660-7R	Rugged	AC-DC	11.1
LM 1001-7R	Rugged	AC-DC	10.1
LM 1301-7R	Rugged	AC-DC	10.1
LM 1501-7R	Rugged	AC-DC	10.1
LM 1601-7R	Rugged	AC-DC	10.1
LM 1901-7R	Rugged	AC-DC	10.1
LM 2320-7	Rugged	AC-DC	10.1
LM 2540-7	Rugged	AC-DC	10.1
LM 3020-7	Rugged	AC-DC	10.1
LM 3040-7	Rugged	AC-DC	10.1
LMZ 1001-7R	Rugged	AC-DC	10.1
LMZ 1301-7R	Rugged	AC-DC	10.1
LMZ 1501-7R	Rugged	AC-DC	10.1
LMZ 1601-7R	Rugged	AC-DC	10.1
LMZ 3020-7	Rugged	AC-DC	10.1
LMZ 3040-7	Rugged	AC-DC	10.1
LS 1001-7R	Rugged	AC-DC	10.1
LS 1301-7R	Rugged	AC-DC	10.1
LS 1501-7R	Rugged	AC-DC	10.1
LS 1601-7R	Rugged	AC-DC	10.1
LS 2320-7R	Rugged	AC-DC	10.1
LS 2540-7R	Rugged	AC-DC	10.1
LS 2660-7R	Rugged	AC-DC	10.1
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LSR 2005-7iP	Industrial	AC-DC	data sheet
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LSR 2012E -7	Industrial	AC-DC	data sheet
LSR 2015-7	Industrial	AC-DC	data sheet
LSR 2024-7	Industrial	AC-DC	data sheet
LSR 2024E -7	Industrial	AC-DC	data sheet

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LSR 3005-7iPCDAX	Industrial	AC-DC	data sheet
LSR 3012-7	Industrial	AC-DC	data sheet
LSR 3015-7iPCDAX	Industrial	AC-DC	data sheet
LSR 3024-7X	Industrial	AC-DC	data sheet
LT 1701-7	Rugged	AC-DC	11.1
LT 1720-7	Rugged	AC-DC	11.1
LT 1730-7	Rugged	AC-DC	11.1
LT 1730-7Z	Rugged	AC-DC	11.1
LT 1740-7	Rugged	AC-DC	11.1
LT 1740-7D	Rugged	AC-DC	11.1
LT 1740-7Z	Rugged	AC-DC	11.1
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LW 30-01	Benign	AC-DC	9.3
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MW 15-11	Benign	AC-DC	9.3
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MW 50-11	Benign	AC-DC	10.3
MW 50-21	Benign	AC-DC	10.3
MW 100-01	Benign	AC-DC	10.3
MWE 15-01	Benign	AC-DC	9.3
MWE 15-11	Benign	AC-DC	9.3
MWE 30-01	Benign	AC-DC	9.3
MWE 30-11	Benign	AC-DC	9.3
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NSR 122.5-7iR	Industrial	Regulator	4.2
NSR 128-7iR	Industrial	Regulator	4.2
NSR 152.5-7	Industrial	Regulator	4.2
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NSR 510-7iR	Industrial	Regulator	4.2
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PSA 123-2	Benign	Regulator	4.3
PSA 123-2iRY	Benign	Regulator	4.3
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PSA 242.5-2	Benign	Regulator	4.3
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PSA 481-7iR	Rugged	Regulator	4.1
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PSB 5A6-7LiPC	Industrial	Regulator	4.2
PSB 5A6-9LiPC	Industrial	Regulator	4.2
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PSB 5A7-7LiPC	Industrial	Regulator	4.2
PSB 5A7-9LiPC	Industrial	Regulator	4.2
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PSB 125-7iR	Industrial	Regulator	4.2
PSB 126-2iR	Benign	Regulator	4.3
PSB 155-7iR	Industrial	Regulator	4.2
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PSB 243-9LiRC	Rugged	Regulator	4.1
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PSC 5A10-9LiPC	Industrial	Regulator	4.2
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PSC 5A12-7iR	Industrial	Regulator	4.2
PSC 5A12-9LiPC	Industrial	Regulator	4.2
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PSC 128-9LiRC	Industrial	Regulator	4.2
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PSC 159-2iR	Benign	Regulator	4.3
PSC 246-7LiR	Rugged	Regulator	4.1
PSC 248-7iR	Industrial	Regulator	4.2
PSC 248-9LiRC	Industrial	Regulator	4.2
PSC 249-2iR	Benign	Regulator	4.3
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PSK 1216-7	Industrial	Regulator	5.2
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PSL 5A12-9LiPC	Industrial	Regulator	5.2
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PSL 486-7LR	Rugged	Regulator	5.1
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PSR 53-7iPY	Industrial	Regulator	4.2
PSR 53-7R	Industrial	Regulator	4.2
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PSR 54-9iR	Industrial	Regulator	4.2
PSR 55	Replaced by	PSB Ind.	4.2
PSR 57	Replaced by	PSB Ind.	4.2
PSR 122.5-7	Industrial	Regulator	4.2
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PSR 122.5-7iRY	Industrial	Regulator	4.2
PSR 122.5-9iR	Industrial	Regulator	4.2
PSR 124	Replaced by	PSB Ind.	4.2
PSR 128	Replaced by	PSC Ind.	4.2
PSR 128E	Replaced by	PSL Ind.	5.2
PSR 152.5-7	Industrial	Regulator	4.2
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PSR 152.5-7iRY	Industrial	Regulator	4.2
PSR 152.5-9iR	Industrial	Regulator	4.2
PSR 154	Replaced by	PSB Ind.	4.2
PSR 158	Replaced by	PSC Ind.	4.2
PSR 158E	Replaced by	PSL Ind.	5.2
PSR 242-7	Industrial	Regulator	4.2
PSR 242-7iR	Industrial	Regulator	4.2
PSR 242-7RY	Industrial	Regulator	4.2
PSR 242-9iR	Industrial	Regulator	4.2
PSR 244	Replaced by	PSB Ind.	4.2
PSR 248	Replaced by	PSC Ind.	4.2
PSR 248E	Replaced by	PSL Ind.	5.2
PSR 362-7iR	Industrial	Regulator	4.2
PSR 364	Replaced by	PSB Ind.	4.2
PSR 368	Replaced by	PSC Ind.	4.2
PSR 368E	Replaced by	PSL Ind.	5.2
PSR 510	Replaced by	PSC Ind.	4.2
PSR 510E	Replaced by	PSL Ind.	5.2
PSR 512	Replaced by	PSC Ind.	4.2
PSR 512E	Replaced by	PSL Ind.	5.2
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SMR 53-7P	Rugged	Regulator	data sheet
SMR 56	Replaced by	PSB Ind.	4.2
SMR 122ER	Replaced by	PSR Ind.	4.2
SMR 123E	Replaced by	PSB Ind.	4.2
SMR 126E	Replaced by	PSC Ind.	4.2
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SW 10-24F	Benign	AC-DC	9.3
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SW 50-24F	Benign	AC-DC	10.3
SW 100-05F	Benign	AC-DC	10.3
SW 100-12F	Benign	AC-DC	10.3
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SWE 10-12F	Benign	AC-DC	9.3
SWE 10-15F	Benign	AC-DC	9.3
SWE 10-24F	Benign	AC-DC	9.3
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SWE 15-12F	Benign	AC-DC	9.3
SWE 15-15F	Benign	AC-DC	9.3
SWE 15-24F	Benign	AC-DC	9.3
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SWE 50-12F	Benign	AC-DC	10.3
SWE 50-24F	Benign	AC-DC	10.3
SWE 100-05F	Benign	AC-DC	10.3
SWE 100-12F	Benign	AC-DC	10.3
SWE 100-24F	Benign	AC-DC	10.3
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USR 2005-7iP	Industrial	AC-DC	data sheet
USR 2024-7	Industrial	AC-DC	data sheet
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VEW 10-48	Industrial	AC-DC	9.2
VEW 15-05	Industrial	AC-DC	9.2
VEW 15-12	Industrial	AC-DC	9.2
VEW 15-15	Industrial	AC-DC	9.2
VEW 15-24	Industrial	AC-DC	9.2
VEW 15-48	Industrial	AC-DC	9.2
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VEW 25-48	Industrial	AC-DC	10.2
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VEW 50-15	Industrial	AC-DC	10.2
VEW 50-24	Industrial	AC-DC	10.2
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VEW 200-24	Industrial	AC-DC	11.2
VEW 200-48	Industrial	AC-DC	11.2
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VRW 15-12A	Benign	AC-DC	9.3
VRW 15-15	Benign	AC-DC	9.3
VRW 15-15A	Benign	AC-DC	9.3
VRW 15-24	Benign	AC-DC	9.3
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VRW 25-24	Benign	AC-DC	9.3
VRW 25-24A	Benign	AC-DC	9.3
VRW 25-48	Benign	AC-DC	9.3

Type	Class	Category	Chapter
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VRW 50-05	Benign	AC-DC	10.3
VRW 50-05A	Benign	AC-DC	10.3
VRW 50-12	Benign	AC-DC	10.3
VRW 50-12A	Benign	AC-DC	10.3
VRW 50-15	Benign	AC-DC	10.3
VRW 50-15A	Benign	AC-DC	10.3
VRW 50-24	Benign	AC-DC	10.3
VRW 50-24A	Benign	AC-DC	10.3
VRW 50-48	Benign	AC-DC	10.3
VRW 50-48A	Benign	AC-DC	10.3
VRW 100-05	Benign	AC-DC	10.3
VRW 100-05A	Benign	AC-DC	10.3
VRW 100-12A	Benign	AC-DC	10.3
VRW 100-15	Benign	AC-DC	10.3
VRW 100-15A	Benign	AC-DC	10.3
VRW 100-24	Benign	AC-DC	10.3
VRW 100-24A	Benign	AC-DC	10.3
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VRW 100-48A	Benign	AC-DC	10.3
VRW 150-05	Benign	AC-DC	11.3
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VRW 150-12A	Benign	AC-DC	11.3
VRW 150-15	Benign	AC-DC	11.3
VRW 150-15A	Benign	AC-DC	11.3
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VRW 150-24A	Benign	AC-DC	11.3
VRW 150-28	Benign	AC-DC	11.3
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VRW 150-48	Benign	AC-DC	11.3
VRW 150-48A	Benign	AC-DC	11.3
VRW 200-05	Benign	AC-DC	11.3
VRW 200-05A	Benign	AC-DC	11.3
VRW 200-15	Benign	AC-DC	11.3
VRW 200-15A	Benign	AC-DC	11.3
VRW 200-24	Benign	AC-DC	11.3
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VRW 300-15A	Benign	AC-DC	11.3
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VRW 450-15A	Benign	AC-DC	11.3
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VSR 30-05	Rugged	AC-DC	10.1
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VSR 60-05	Rugged	AC-DC	11.1
VSR 60-15	Rugged	AC-DC	11.1
VSR 60-24	Rugged	AC-DC	11.1
VSR 60-48	Rugged	AC-DC	11.1
VSR 120-05	Rugged	AC-DC	11.1
VSR 120-15	Rugged	AC-DC	11.1
VSR 120-24	Rugged	AC-DC	11.1
VSR 120-48	Rugged	AC-DC	11.1
VSR 170-05	Rugged	AC-DC	11.1
VSR 170-15	Rugged	AC-DC	11.1
VSR 170-24	Rugged	AC-DC	11.1
VSR 170-48	Rugged	AC-DC	11.1
VSR 330-05	Rugged	AC-DC	11.1
VSR 330-15	Rugged	AC-DC	11.1
VSR 330-24	Rugged	AC-DC	11.1
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N: Coombs Inc.
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S: MTS
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CE Tech
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S: Jacobsen
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