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MELCHER AG, Ackerstrasse 56, CH-8610 Uster, Switzerland
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6-Watt-DC-DC-Converter Dual output voltage

Families FCR 12CR 24CR

Full integral input to output isolation
With input filter

Input voltage ranges*:

Familly	**FCR 6:**	**5V ±5%**
Familly	**12CR 6:**	**12V ±5%**
Familly	**24CR 6:**	**24V ±5%**

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1 Brief Description

The FCR, 12CR and 24CR families of DC-DC-converters have been developed for the expansion of single power supplies into multiple output configura-tions. Particular emphasis in design was placed on low output ripple, low module height, high quality and reliability.

The converters are particulary suitable for pcb-mounting.
Case: metal, black finish,fully enclosed, selfcooling, 52x77x11mm.
Weight: 85g.

Features

- High efficiency (57-69%)
- Full isolation between input/output/output.
- Input filter.
- Two regulated output voltages.
- Thermally protected..
- Parallel and series wiring
- Height of 11 mm only.
- No derating required.
- Metal case.
- IEC-type-1 electrolytic capacitors.
- Undervoltage cut-out.
- Epoxy resin base plate.

Benefits

low heat generation, high reliability
allows free choice of reference potential
noise levels according to VDE 0871
simple realization of multiple output configurations
continuously short-circuit-proof, simple to handle
versatile application
compact circuitry and system design
full load handling capability over entire temperature range
no additional cooling necessary
long service life
prevents malfunction at insufficient voltage levels
easy mounting on double sided printed circuit boards

2 Type Survey

Nominal output voltage $U_{o1\ nom}$	Nominal output current $I_{o1\ max}$	Nominal output voltage $U_{o2\ nom}$	Nominal output current $I_{o2\ max}$	Type
5 V DC	200 mA	5 V DC	1 A	12CR 6-0505-6
				24CR 6-0505-6
12 V DC	450 mA	5 V DC	100 m A	FCR 6-1205-6
	85 mA		1 A	12CR 6-1205-6
				24CR 6-1205-6
12 V DC	250 mA	12 V DC	250 mA	FCR 6-1212-6
				12CR 6-1212-6
				24CR 6-1212-6
15 V DC	200 mA	15 V DC	200 mA	FCR 6-1515-6
				12CR 6-1515-6
				24CR 6-1515-6

Other output voltages and currents on request.
*see page 7, «Application Notes».

Printed in Switzerland 07.88
Supersedes all previous issues
Subject to change

3 Functional Description

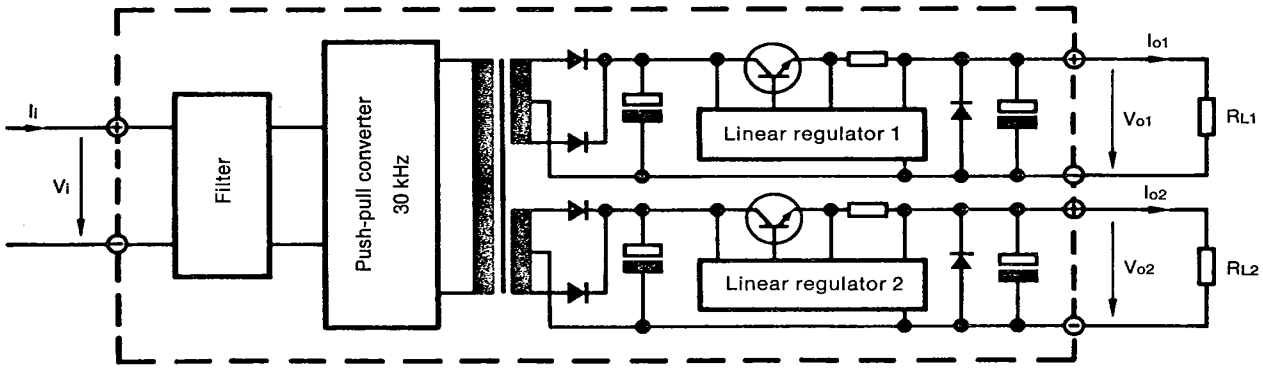

Fig. 1
Block diagram

To minimize feedback effects in the supply system, the modules are equipped with input low-pass filters. A push-pull converter powers two secondary linear voltage regulators,with good regulating characteristics.

Both outputs are equipped with thermal protection, which provides short-circuit-proof operation throughout the entire temperature range.

4 Special Features

Input Undervoltage Cut-out

Below approx. 0.7 to 0.9 x $U_{i\,min.}$ an internal inhibit signal keeps the output voltage switched off.

Input to Output Isolation

With power transformer.

Continuous Open and Short-Circuit-Proof

Through the entire temperature range, by using a thermal control circuit and an electronic output current limitation.

No Output Voltage Overshoot

When switching input on or off, or after short circuit and power failure.

Self-Cooling Case

When a converter is located in free, quasi-stationary air at a temperature T_A = +71°C (+66°C*) and is operated at its nominal output power, the case temperature T_C will stabilize at about +95°C. Under practical operating conditions the ambient temperature T_A may exceed +71°C (+66°C*), provided additional measures are taken to ensure that the case temperature T_C does not exceed +95°C.

* Valid for 5V,1A converters

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5 Data FCR

General Conditions: $T_A = +25°C$, unless T_C is specified.

Output

Characteristics		Conditions	FCR 6-1205-6 min	typ	max	FCR 6-1212-6 min	typ	max	FCR 6-1515-6 min	typ	max	Unit
U_{o1}	Output voltage	$U_I = 5.0$ V DC	11.92	12.00	12.07	11.92	12.00	12.07	14.91	15.00	15.09	V
U_{o2}		I_{o1} max, I_{o2} max	4.97	5.00	5.03	11.92	12.00	12.07	14.91	15.00	15.09	
I_{o1}	Output current	$U_{I\,min}$...$U_{I\,max}$	0		450	0		250	0		200	mA
I_{o2}		$T_{C\,min}$...$T_{C\,max}$	0		100	0		250	0		200	
$I_{o\,L}$	Output current limitation threshold	$U_{I\,min}$...$U_{I\,max}$	1.4 I_o max (Fig. 4)			1.4 I_o max (Fig. 4)			1.4 I_o max (Fig. 4)			
u_{o1}	Output ripple	$U_{I\,min}$...$U_{I\,max}$, I_{o1} max		10	20		10	20		10	20	mV_{pp}
				1	2		1	2		1	2	mV_{eff}
u_{o2}	(BW = 20 MHz)			10	20		10	20		10	20	mV_{pp}
				1	2		1	2		1	2	mV_{eff}
$\Delta U_{o1\,U}$	Static control			4	6		4	7		5	8	mV
$\Delta U_{o2\,U}$	deviation versus input voltage U_I	I_{o2} max		2	3		4	7		5	8	
$\Delta U_{o1\,I}$	Static control	$U_I = 5.0$ V DC		3	6		4	7		5	8	mV
$\Delta U_{o2\,I}$	devation versus output current I_o	$I_{o1} = 0$...I_{o1} max, $I_{o2} = 0$...I_{o2} max		6	10		4	7		5	8	
$u_{o\,d}$	Dynamic control deviation	$U_I = 5.0$ V DC		±25			±25			±25		mV
t_{rr}	Load trans. recovery time	$\Delta I_o = \pm 0.8 I_o$ max		7			7			7		µs
α_{U_o}	Temperature coefficient $\Delta U_o / \Delta T$	$U_{I\,min}$...$U_{I\,max}$, $I_{o\,min}$...$I_{o\,max}$, $I_{o1} = 0$...I_{o1} max, $I_{o2} = 0$...I_{o2} max, T_{Cmin}–T_{Cmax}			±0.003			±0.003			±0.003	%/K

Input

U_I	Input voltage*	$I_{o1} = 0$...I_{o1} max, $I_{o2} = 0$...I_{o2} max, $T_{C\,min}$...$T_{C\,max}$	4.75		5.25	4.75		5.25	4.75		5.25	V
$I_{I\,0}$	Input quiescent current	$U_I = 5.0$ V DC, $I_{o1} = I_{o2} = 0$		210	250		210	250		210	250	mA
$U_{I\,rfi}$	RFI suppression at input 0.01...30MHz	VDE 0871, I_{o1} max, I_{o2} max, $U_I = 5.0$ V DC			B			B			B	VDE0871

Efficiency

η	Efficiency	$U_I = 5.0$ V DC, I_{o1} max, I_{o2} max	64		65	65		66	66		68	%

Isolation

$U_{is\,io}$	Isolation test voltage input to output	50 Hz, 1min	500			500			500			V_{eff}
$U_{is\,oo}$	Isolation test voltage output to output	1 min	100			100			100			V DC
$R_{is\,oo}$	Isolation resistance output to output	100 V DC after 1 min		2000			2000			2000		MΩ
C_{io}	Capacitance input to each output			70			70			70		pF

*see page 7, «Application Notes».

6 Data 12CR

General Conditions: $T_A = +25°C$, unless T_C is specified.

Output

Characteristic		Conditions	12CR 6-0505-6 min	typ	max	12CR 6-1205-6 min	typ	max	12CR 6-1212-6 min	typ	max	12CR 6-1515-6 min	typ	max	Unit
U_{o1}	Output voltage	U_i = 12 V DC	4.97	5.00	5.03	11.92	12.00	12.07	11.92	12.00	12.07	14.91	15.00	15.09	V
U_{o2}		I_{o1} max I_{o2} max	4.97	5.00	5.03	4.97	5.00	5.03	11.92	12.00	12.07	14.91	15.00	15.09	
I_{o1}	Output current	$U_{i\,min}$...$U_{i\,max}$	0		200	0		85	0		250	0		200	mA
I_{o2}		$T_{C\,min}$...$T_{C\,max}$	0		1000	0		1000	0		250	0		200	
$I_{o\,L}$	Output current limitation threshold	$U_{i\,min}$...$U_{i\,max}$	1.4 I_o max (Fig. 4)			1.4 I_o max (Fig. 4)			1.4 I_o max (Fig. 4)			1.4 I_o max (Fig. 4)			
u_{o1}	Output ripple	$U_{i\,min}$...$U_{i\,max}$ I_{o1} max		10	20		10	20		10	20		10	20	mV_{pp}
				1	2		1	2		1	2		1	2	mV_{eff}
u_{o2}	(BW = 20 MHz)			50	100		50	100		10	20		10	20	mV_{pp}
		I_{o2} max		1	2		1	2		1	2		1	2	mV_{eff}
$\Delta U_{o1\,U}$	Static control deviation versus input voltage U_i			2	3		2.5	5		4	7		5	8	mV
$\Delta U_{o2\,U}$				2	4		2	4		4	7		5	8	
$\Delta U_{o1\,I}$	Static control deviation versus output current I_o	U_i = 12 V DC I_{o1} = 0...$I_{o1\,max}$ I_{o2} = 0...$I_{o2\,max}$		2.5	5		2	5		4	7		5	8	mV
$\Delta U_{o2\,I}$				7.5	15		7.5	15		4	7		5	8	
$u_{o1\,d}$	Dynamic control deviation	U_i = 12 V DC		±25			±25			±25			±25		mV
$u_{o2\,d}$				±60			±60								
t_{rr}	Load trans.recovery time	ΔI_o = ±0.8 $I_{o\,max}$		15			15			7			7		µs
$\alpha_{U\,o}$	Temperature coefficient $\Delta U_o / \Delta T$	$U_{i\,min}$...$U_{i\,max}$ $I_{o\,min}$...$I_{o\,max}$ I_{o1} = 0...$I_{o1\,max}$ I_{o2} = 0...$I_{o2\,max}$ T_{cmin}...T_{cmax}		±0.003			±0.003			±0.003			±0.003		%/K

Input

U_i	Input voltage*	I_{o1} = 0...$I_{o1\,max}$ I_{o2} = 0...$I_{o2\,max}$ $T_{C\,min}$...$T_{C\,max}$	11.4		12.6	11.4		12.6	11.4		12.6	11.4		12.6	V
$I_{i\,0}$	Input quiescent current	U_i = 12 V DC I_{o1} = I_{o2} = 0		55	66		55	66		55	66		55	66	mA
$U_{i\,rfi}$	RFI suppression at input 0.01...30MHz	VDE0871 $I_{o1\,max}$, $I_{o2\,max}$ U_i = 12 V DC			A*			A*			A*			A*	VDE0871

* Will be reduced to < B by adding a capacitor (220 µF/25 V) at the input

Efficiency

η	Efficiency	U_i = 12 V DC $I_{o1\,max}$, $I_{o2\,max}$	58	60		59	61		68	70		69	71		%

Isolation

$U_{is\,io}$	Isolation test voltage input-outputs	50 Hz, 1 min	500			500			500			500			V_{eff}
$U_{is\,oo}$	Isolation test voltage output to output	1 min	100			100			100			100			V DC
$R_{is\,oo}$	Isolation resistance output to output	100 V DC after 1 min		2000			2000			2000			2000		MΩ
C_{io}	Capacitance input to each output			70			70			70			70		pF

*see page 7, «Application Notes».

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7 Data 24CR

General Condition: $T_A = +25°C$, unless T_C is specified.

Output

Characteristics		Conditions	24CR 6-0505-6 min	typ	max	24CR 6-1205-6 min	typ	max	24CR 6-1212-6 min	typ	max	24CR 6-1515-6 min	typ	max	Unit
U_{o1}	Output voltage	U_I = 24 V DC	4.97	5.00	5.03	11.92	12.00	12.07	11.92	12.00	12.07	14.91	15.00	15.09	V
U_{o2}		I_{o1} max I_{o2} max	4.97	5.00	5.03	4.97	5.00	5.03	11.92	12.00	12.07	14.91	15.00	15.09	
I_{o1}	Output current	$U_{I\,min}$...$U_{I\,max}$	0		200	0		85	0		250	0		200	mA
I_{o2}		$T_{C\,min}$...$T_{C\,max}$	0		1000	0		1000	0		250	0		200	
$I_{o\,L}$	Output current limitation threshold	$U_{I\,min}$...$U_{I\,max}$	1.4 $I_{o\,max}$ (Fig. 4)			1.4 $I_{o\,max}$ (Fig. 4)			1.4 $I_{o\,max}$ (Fig. 4)			1.4 $I_{o\,max}$ (Fig. 4)			
u_{o1}	Output ripple (BW = 20 MHz)	$U_{I\,min}$...$U_{I\,max}$ I_{o1} max I_{o2} max		15	30		15	30		15	30		15	30	mV_{pp}
				1	2		1	2		1	2		1	2	mV_{eff}
u_{o2}				50	100		50	100		15	30		15	30	mV_{pp}
				1	2		1	2		1	2		1	2	mV_{eff}
$\Delta U_{o1\,U}$	Static control deviation versus input voltage U_I			2	3		2.5	5		4	7		5	8	mV
$\Delta U_{o2\,U}$				2	4		2	4		4	7		5	8	
$\Delta U_{o1\,I}$	Static control deviation versus output current I_o	U_I = 24 V DC		2.5	5		3	5		4	7		5	8	mV
$\Delta U_{o2\,I}$		$I_{o1} = 0...I_{o1\,max}$ $I_{o2} = 0...I_{o2\,max}$		7.5	15		7.5	15		4	7		5	8	
$u_{o1\,d}$	Dynamic control deviation	U_I = 24 V DC		±25			±25			±25			±25		mV
$u_{o2\,d}$		$\Delta I_o = \pm 0.8 I_{o\,max}$		±60			±60								
t_{rr}	Load trans. recovery time			15			15			7			7		µs
α_{Uo}	Temperature coefficient $\Delta U_o / \Delta T$	$U_{I\,min}$...$U_{I\,max}$ $I_{o\,min}$...$I_{o\,max}$ $I_{o1} = 0...I_{o1\,max}$ $I_{o2} = 0...I_{o2\,max}$ T_{cmin}...T_{cmax}		±0.003			±0.003			±0.003			±0.003		%/K

Input

U_I	Input voltage*	$I_{o1} = 0...I_{o1\,max}$ $I_{o2} = 0...I_{o2\,max}$ $T_{C\,min}$...$T_{C\,max}$	22.8		25.2	22.8		25.2	22.8		25.2	22.8		25.2	V
$I_{I\,0}$	Input quiescent current	U_I = 24 V DC $I_{o1} = I_{o2} = 0$		30	40		30	40		30	40		30	40	mA
$U_{I\,rfi}$	RFI suppression at input 0.01...30MHz	VDE0871 $I_{o1\,max}$, $I_{o2\,max}$ U_I = 24 V DC			G*			G*			G*			G*	VDE0871

* Will be reduced to < B by adding a capacitor (220 µF/40 V) at the input

Efficiency

η	Efficiency	U_I = 24 V DC $I_{o1\,max}$, $I_{o2\,max}$	57	59		58	60		68	70		68	70		%

Isolation

$U_{is\,io}$	Isolation test voltage input to outputs	50 Hz, 1 min	500			500			500			500			V_{eff}
$U_{is\,oo}$	Isolation test voltage output to output	1 min	100			100			100			100			V DC
$R_{is\,oo}$	Isolation resistance output to output	100 V DC after 1 min		2000			2000			2000			2000		MΩ
C_{io}	Capacitance input to each output			70			70			70			70		pF

*see page 7, «Application Notes».

8 Environmental Conditions

Temperature

Characteristics		Conditions	12CR 6-1212-6 /-1515-6 24CR 6-1212-6 /-1515-6 all FCR 6		12CR 6-0505-6 /-1205-6 24CR 6-0505-6 /-1205-6		Unit
			min	max	min	max	
T_A	Ambient temperature	$U_{I\ min}$ ... $U_{I\ max}$ $I_o = 0 ... I_{o\ max}$	-25	+71	-25	+66	°C
T_C	Case temperature		-25	+95	-25	+95	
T_S	Storage temp.		-40	+95	-40	+95	

Environmental tests

Test method		Standard No.	Test conditions	
Ca	Damp heat steady state	DIN 40046 part 5 IEC 68-2-3	Temperature: Relative humidity: Time:	40 ± 2°C 93 $^{+2}_{-3}$ % 56 days Converter not operating
Ea	Shock (half-sinusoidal)	DIN 40046 part 7 IEC 68-2-27	Acceleration amplitude : Duration of shock: Number of shocks:	100 g_n = 981 m/s² 6 ms 9 (3 each axis) Converter operating
Eb	Bump (half-sinusoidal)	DIN 40046 part 26 IEC 68-2-29	Acceleration amplitude : Bump duration: Number of bumps:	40 g_n = 392 m/s² 6 ms 6000 (2000 each axis) Converter operating
Fc	Vibration (sinusoidal)	DIN 40046 part 8 IEC 68-2-6	Frequency (1 Okt/min): Vibration amplitude : Acceleration amplitude : Time:	10...2000 Hz 0.35 mm 5 g_n = 49 m/s² 7 ½ h (2 ½ h each axis) Converter operating
Transient input voltage test		IEC 255.4 Appendix E	Class II:	1 kV (1.2/50; 500Ω) Converter not operating
High-frequency disturbance test			Class III:	long: 2.5kV trans: 1kV (200Ω) Converter operating

MTBF according to MIL-HDBK-217D	Temp.	Ground fixed	Ground mobile
	40°C	260 000 hrs	180 000 hrs
	70°C	130 000 hrs	90 000 hrs

9 Characteristics and Definitions

Dynamic

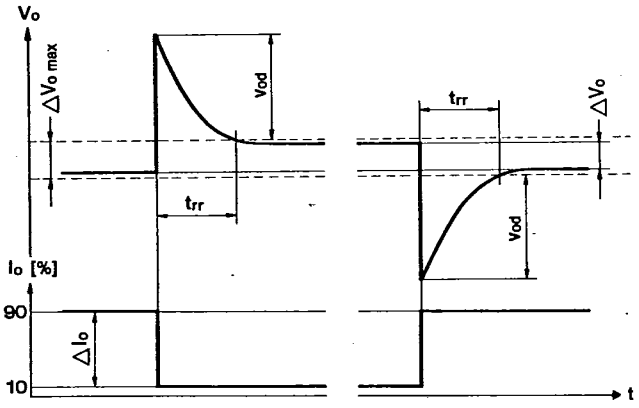

Fig. 2
Dynamic characteristics

Measurements

The output voltage should be measured directly at the output terminals with separate test leads. Otherwise, the measurement will be falsified by the magnitude of the voltage drop across the consumer lead length. Test clips can have resistances up to 100 mΩ.

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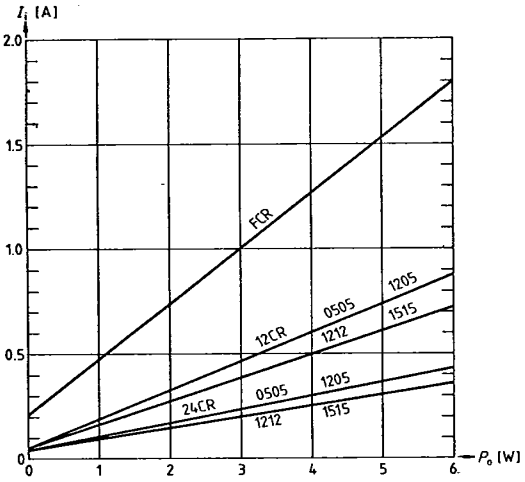

Fig. 3
Input current I_i
versus output power P_o

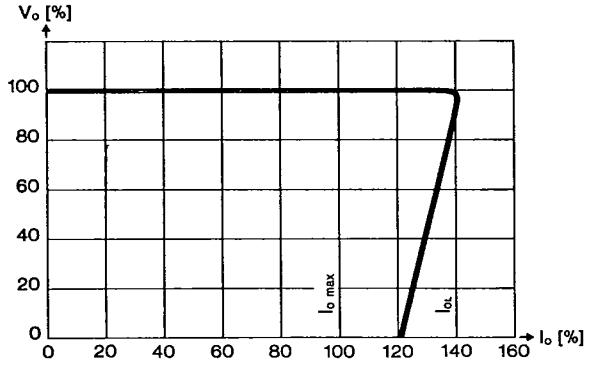

Fig. 4
Short-circuit behavior Output voltage U_o
versus output current I_o

10 Application Notes

Higher Output Ratings

The outputs of one or several DC-DC-converters can be connected in parallel or in series to achieve higher output ratings. However, the maximum case temperature T_{cmax} shall not be exceeded.

Soldering Temperature

Max. 280 °C, 5 s

Cleaning Agents

The DC-DC Converters are **not hermetically sealed.** In order to avoid damage any ingress of cleaning fluids must be prevented.

Mounting

If DC-DC-modules are operated in harsh environments (shock, vibration), we recommend an additional mechanical fixing.

Using CR modules at U_i +10%

When using CR modules at $U_{i\,nom}$ +10% the output power must be derated by 20%. Operation under the above conditions is permitted over the temperature range of -25...+71 °C. For operation at $I_{0\,max}$ and $U_{i\,nom}$ +10% the maximum ambient temperature $T_{A\,max}$ must be reduced at 15 °K. The maximum case temperature of T_C = 90 °C should not be exceeded.

Application Example

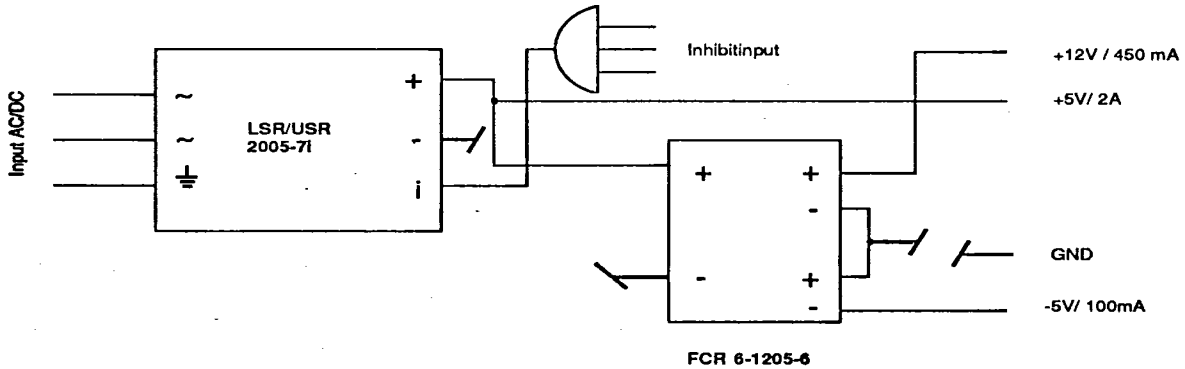

Fig. 5
Microprocessor power supply with LSR 3005-7i
and FCR 6-1205-6

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11 Mechanical Data

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

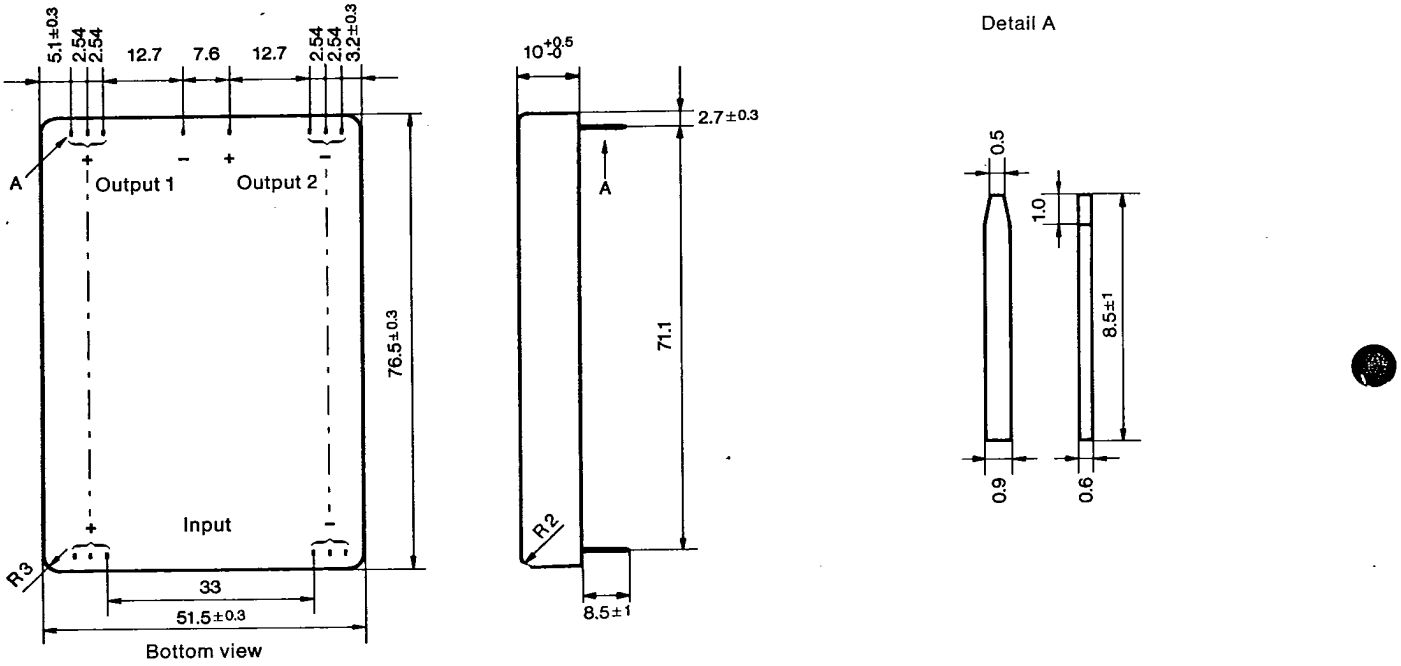

Fig. 6
Case: G01, Weight: 85 g

The black finished metal case serves as a heat radiator. This allows module operation at maximum temperature ($T_{A\,max}$) and at maximum output current ($I_{o\,max}$) without derating.

Furthermore, the bottom of the case is covered with a laminated epoxy resin panel on one side. This element not only provides shielding but also insulates, when double-sided circuit boards are used.

12 Accessories

Printed Circuit Board Type PCG

European format board 100 x 160 x 1.6 mm, suitable for mounting of one or two modules of the families FCR, 12 CR or 24CR with holes for fixing a front panel. Male connector according to DIN 41 612, part 2, design C (three parts, 96 pins).

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