IBEK DC-DC Converters

6 Watt-Family

Input to output isolation test voltage 500 V_{rms}
Single output of 5 V DC, 5 W
Single and dual output of 12 V DC & 15 V DC, 6 W
Input voltages of 5, 12, 15, 24, 28 and 48 V DC

- Efficient Pi input filter
- Outputs equipped with linear voltage regulation
- High reliability
- Optimal dynamic response
- Continuous no-load and short-circuit proof
- Operating ambient temperature range up to –40...85°C (optional)
- Case height only 10.5 mm

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Description

The DC-DC converters have been developed as a response to the increasing need for decentralised power supply systems. They are especially suitable for powering medium loads on PCBs and for realising redundant systems. The DC-DC converters feature high efficiency, low output ripple, low module height, high quality and reliability. To minimise feedback effects in the supply system, the modules are equipped with an efficient low-pass Pi input filter.

All modules are manufactured according to ISO 9001.

Case: 2"×2" metal, black anodized, self cooling (free air convection).

Type Survey

General Condition: T_A = 25 °C

Table 1: Type survey

Output $U_{o\,nom}$ [V DC]	Output $I_{o\,nom}$ [mA]	Input $U_{i\,nom}$ [V DC]	Typ. no load Input Current ($U_{i\,nom}$, I_o = 0) [mA]	Efficiency η (typ.) [%]	Group [1]	Type [2]	Pin-Config.	Option
5 12 15	1000 500 400	5	32 46 52	68 72 72	01	5 ICR 5-05-T.. 5 ICR 6-12-T.. 5 ICR 6-15-T..	C, B	S
±12 ±15	±250 ±200		125 150	68 70	02	5 ICR 6-1212-T.. 5 ICR 6-1515-T..		
5 12 15	1000 500 400	12	20 25 30	70 75 75	01	12 ICR 5-05-T.. 12 ICR 6-12-T.. 12 ICR 6-15-T..		
±12 ±15	±250 ±200		60 63	72 73	02	12 ICR 6-1212-T.. 12 ICR 6-1515-T..		
5 12 15	1000 500 400	15	18 19 20	72 75 75	01	15 ICR 5-05-T.. 15 ICR 6-12-T.. 15 ICR 6-15-T..		
5 12 15	1000 500 400	24	18 19 20	72 76 76		24 ICR 5-05-T.. 24 ICR 6-12-T.. 24 ICR 6-15-T..		
±12 ±15	±250 ±200		37 39	74 75	02	24 ICR 6-1212-T.. 24 ICR 6-1515-T..		
5 12 15	1000 500 400	28	18 19 20	72 76 76	01	28 ICR 5-05-T.. 28 ICR 6-12-T.. 28 ICR 6-15-T..		
±12 ±15	±250 ±200		34 36	75 75	02	28 ICR 6-1212-T.. 28 ICR 6-1515-T..		
5 12 15	1000 500 400	48	12 13 14	70 72 72	01	48 ICR 5-05-T.. 48 ICR 6-12-T.. 48 ICR 6-15-T..		
±12 ±15	±250 ±200		28 30	73 73	02	48 ICR 6-1212-T.. 48 ICR 6-1515-T..		

[1] See "Block Diagrams"
[2] Pin configuration should be added to the type designation (e.g. 5 ICR 5-05-TC)

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Safety Instructions

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

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

If the following table is observed, the output of any DC-DC converter is considered to be an SELV circuit up to a nominal output voltage of 30 V (2 x 15 V in series).

Table 2: Insulation concept for SELV circuits

Nominal mains supply voltage (AC)	Minimum required grade of isolation, to be provided by the AC-DC front end, including mains supplied battery charger	Maximum output voltage from the front end	Minimum required safety status of the front end output circuit	Minimum required grade of isolation between the input and the output of the DC-DC converter, provided by the converter	Resulting safety status of the DC-DC converter output circuit
≤250 V	Basic	≤60 V	Earthed SELV circuit [1]	Operational	SELV circuit
		≤65 V	Unearthed hazardous voltage secondary circuit [2]	Operational	Earthed SELV circuit [1]
	Double or reinforced	≤60 V	SELV circuit	Operational	SELV circuit
		≤65 V	Double or reinforced insulated unearthed hazardous voltage secondary circuit, supplying an SELV circuit [3]	Operational	

[1] The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC 950.
[2] Has to be insulated from earth by at least basic insulation according to the relevant safety standard, based on the maximum input voltage of the DC-DC converter.
[3] Has to be insulated from earth by double or reinforced insulation according to the relevant safety standard, based on the maximum input voltage of the DC-DC converter.

Immunity to Environmental Conditions

Thermal Considerations

Table 3: Temp. specification values given are valid for air pressures in the range 800...1200 hPa (800...1200 mbar)

Characteristics		Conditions	Standard -T		Option -S [1]		Unit
			min	max	min	max	
T_A	Ambient temperature	$U_{i\,min}...U_{i\,max}$ $I_o = 0...I_{o\,nom}$	–25	71	–40	85	°C
T_C	Case temperature		–25	95	–40	105	
T_S	Storage temperature	not operational	–55	105	–55	105	

[1] ICR 6: Linear derating of the output power from 6 to 5 watts for T_A = 71°C to 85°C.

The case temperature T_C must not exceed the maximum value. In applications with limited air circulation, additional measures must be taken (either larger spacing or a fan) to avoid case temperatures higher than $T_{C\,max}$!

Table 4: MTBF

Values at specified Case Temperature	Modules Types	Ground Benign	Ground Fixed		Ground Mobile		Unit
		40°C	40°C	70°C	40°C	70°C	
MTBF according to MIL-HDBK-217F	Single output	2'150'000	570'000	270'000	190'000	90'000	h
	Double output	1'850'000	510'000	250'000	150'000	70'000	

Electrical Input and Output Data

General Conditions: T_A = 25°C

Table 5: Input Data

Input				5 V	12 V	15 V	24 V	28 V	48 V	
Characteristics			Conditions							Unit
U_i	Input voltage range at 60% load	min max	DC	4.40 6.50	10.56 15.60	13.20 19.50	21.12 31.20	24.64 36.40	42.24 62.40	V
	Input voltage range at 80% load	min max		4.50 6.00	10.80 14.40	13.50 18.00	21.60 28.80	25.20 33.60	43.20 57.60	
	Input voltage range at 100% load	min max		4.65 5.50	11.16 13.20	13.95 16.50	22.32 26.40	26.04 30.80	44.64 52.80	
$i_{i\,rfi}$	RFI current at the input	typ max	$U_{i\,nom}$, $I_{o\,nom}$ L_{source} = 1 µH	1% $_{pp}$ of I_i 3% $_{pp}$ of I_i						
$U_{i\,abs}$	Input voltage limits without any damage	max	max 60 s	6.75	6.20	20.25	32.40	37.80	64.80	V
f_s	Switching frequency	min max	$U_{i\,nom}$, $I_{o\,nom}$	20 40						kHz

Table 6: Output Data

Output				5 V	12 V	15 V	
Characteristics			Conditions				Unit
U_o	Output voltage		$U_{i\,nom}$, $I_{o\,nom}$	5	12	15	V
$\Delta U_{o\,a}$	Output voltage accuracy	max		±0.5			%
I_{oL}	Output current limitation response	typ	$U_{i\,nom}$	1.25 $I_{o\,nom}$			
I_{oS}	Short-circuit current of the output	typ max	$U_{i\,nom}$, U_o = 0	1.4 $I_{o\,nom}$ 2.0 $I_{o\,nom}$			
u_o	Output voltage noise	max	$U_{i\,nom}$, $I_{o\,nom}$ (BW = 20 MHz)	1			mV_{rms}
				35			mV_{pp}
$\Delta U_{o\,U}$	Static line regulation	typ	$U_{i\,min}$…$U_{i\,max}$ $I_{o\,nom}$	±0.05			%
$\Delta U_{o\,I}$	Static Load regulation	typ	$U_{i\,nom}$ I_o = 0…$I_{o\,nom}$	±0.1			
u_{od}	Dynamic load regulation	max		50			mV
t_{rr}	Load transient recovery time	typ		20			µs
α_{Uo}	Temperature coefficient	typ max	$U_{i\,nom}$, $I_{o\,nom}$	±0.01 ±0.03			%/K

Table 7: Efficiency

Efficiency				5 V	12 V	15 V	
Characteristics			Conditions				Unit
η	Efficiency	min typ	$U_{i\,nom}$, $I_{o\,nom}$	68 75			%

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Installation Instructions

Isolation Tests

Input to output isolation voltage tests are performed as factory tests (100%) and should not be repeated in the field. Melcher will not honour any guarantee/warranty claims resulting from high voltage field tests.

Table 8: Isolation test voltage, coupling capacitance and insulation resistance

Characteristics		Conditions	ICR	Unit
$U_{is\ io}$	Isolation test voltage Input to output	AC: 50 Hz, 1 minute	500	V_{rms}
			1400	V_{pp}
		DC: 1 second [1]	700	V
		DC: 1 second [2]	800	
C_{io}	Coupling capacitance typ		70	pF
R_{is}	Insulation resistance	at 100 V DC after 1 minute	≥1000	MΩ

[1] For production test purposes in accordance with IEC 950/ EN 60950
[2] Factory test procedure

Connection in Series

If the outputs of one or more units are connected in series each individual output should be protected by a zener diode or preferably by a suppressor diode to avoid overvoltages or reverse polarity at the individual outputs, e.g.:
– 1N5908 to protect 5 V outputs
– BZW04-11 to protect 12 V outputs
– BZW04-14 to protect 15 V outputs
(or equivalent types)

Such destructive voltages may occur at switch-on cycle of the converters, if the output voltages do not rise at the same time. The "slower" output(s) could be supplied and, as a result, destroyed by the "faster" output(s) via the load. The maximum output current is limited by the lowest current limitation.

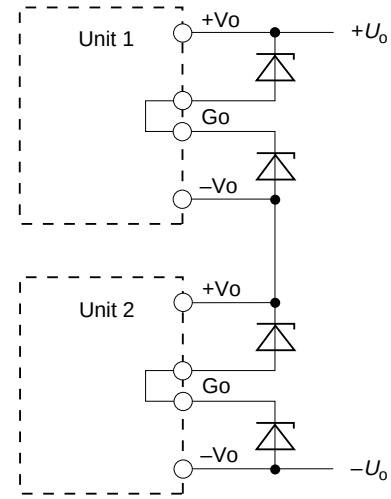


Fig. 1
Outputs connected in series

Connection in Parallel

Connection of the outputs of one or more units in parallel is not permitted. The load distribution and the ripple values could not be controlled.

Exception: .. ICR 5-05 (all 5 V single output units)

Cleaning

Two CFC free cleaning solvents have been tested and can be recommended:
– Prozone from BP
– Zestron from Dr. O. K. Wack Chemie GmbH (Germany)

Submersion of the units in water for rinsing is permitted. Drying should be done in the air.

Block Diagrams

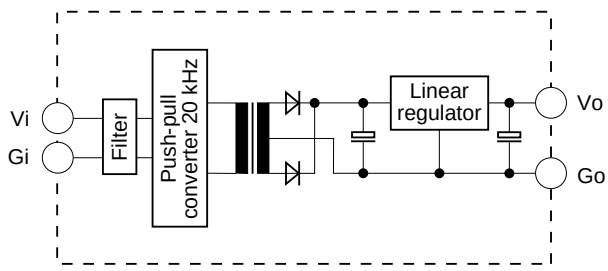


Fig. 2
ICR 5/6, group 01 (single output)

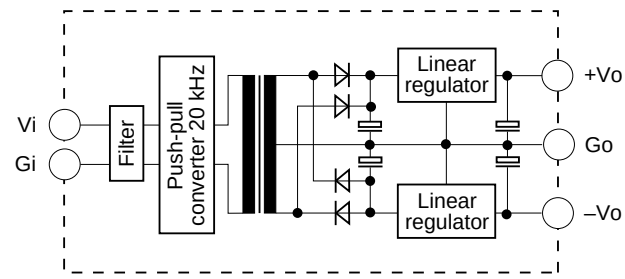


Fig. 3
ICR 5/6, group 02 (dual output)

Mechanical Data

Dimensions in mm. Tolerances ±0.2 mm, unless otherwise specified.

European Projection

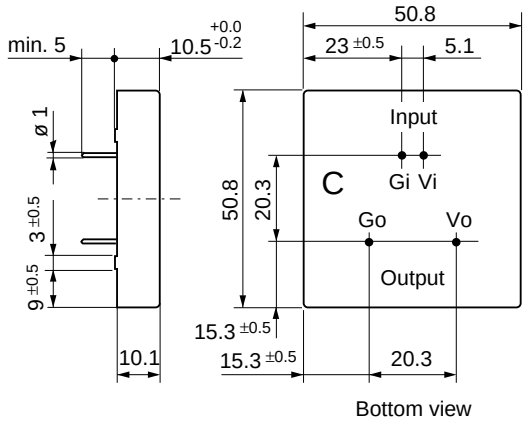


Fig. 4
Single output, pin configuration C

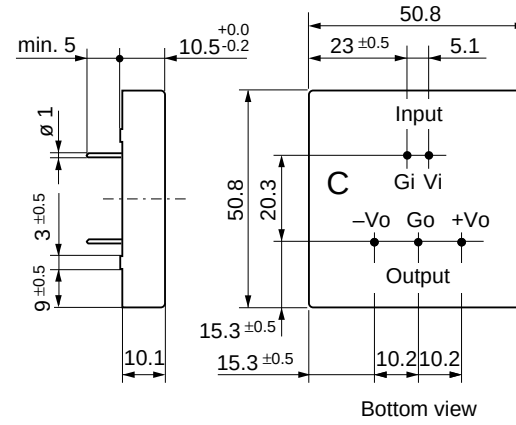


Fig. 5
Double output, pin configuration C

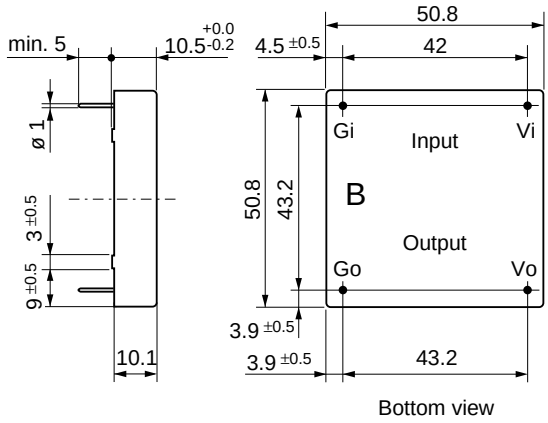


Fig. 6
Single output, pin configuration B

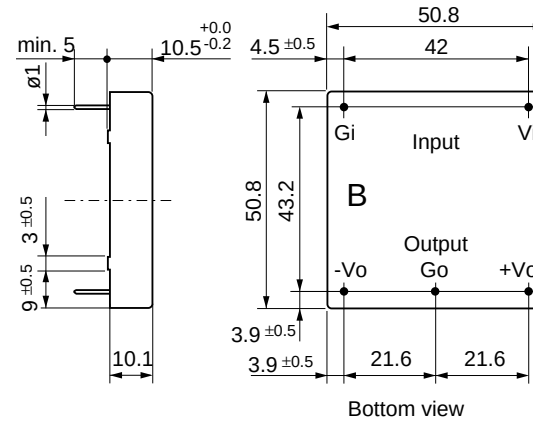
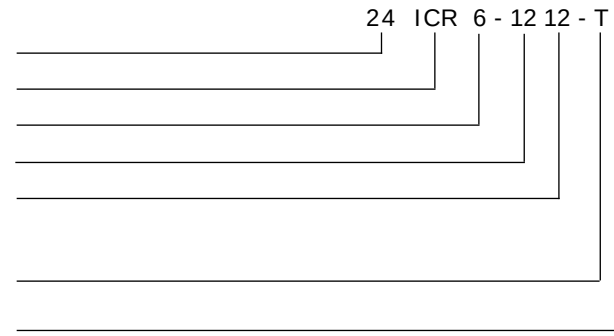


Fig. 7
Double output, pin configuration B

Type Key and Product Marking

Type Key



Nominal input voltage in volt 5, 12, 15, 24, 28, 48
Family ..... ICR
Nominal output power in watt 5, 6
Nominal output voltage for output 1 in volt 05, 12, 15
Nominal output voltage for output 2 in volt 12, 15
Ambient temperature range
TA = –25...71°C ..... T
TA = –40...85°C ..... S
Pin configuration ..... C, B

Product Marking:

Main face: Manufacturer's name (IBEK), specific type designation, input and output pin allocation.
Bottom: Date code.

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