

IBEK DC-DC Converters

1 Watt-Family

Input to output isolation test voltage up to 5 kV_{rms}
1 or 2 Outputs: ICR 1, IXR 1, IYR 1, IZR 1
1, 2 or 4 Outputs: IWR 1

- Extremely high isolation test voltages
- Efficient PI input filter
- Aluminium solid electrolytic capacitors (OS-CON)
- Outputs equipped with linear voltage regulators
- High reliability
- Optimal dynamic response
- Operating ambient temperature range up to -40...85°C (optional)
- Case height only 10.5 mm

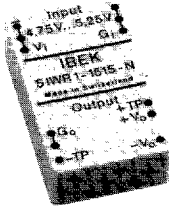


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Description

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 small loads on PCBs and for realising redundant systems. Five input to output isolation test voltage categories and three temperature ranges are available. The DC-DC converters feature low output ripple, low module height, high

quality and reliability. To minimize 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: DIL 24 package, grey colored plastic material, self cooling (free air convection).

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Type Survey

General Condition: $T_A = 25^\circ\text{C}$

Table 1a: Type survey ICR 1 and IWR 1

Output 1 ¹		Output 2		Input Voltage ¹	Group ²	700 V DC/500 V _{rms} Isolation test voltage Type ¹	Group ²	1500 V DC/1060 V _{rms} Isolation test voltage Type ¹	Option
$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	U_i [V DC]					
5	200	-	-	5 ($\pm 5\%$)	06	.. ICR 1-05-N	01	.. IWR 1-05-N	T, S
12	80	-	-	or		.. ICR 1-12-N		.. IWR 1-12-N	
15	66	-	-	12 ($\pm 10\%$)		.. ICR 1-15-N		.. IWR 1-15-N	
± 5	± 50	-	-	or	07	.. ICR 1-1212-N ^{3,4}	02	.. IWR 1-0505-N	
± 12	± 40	-	-	15 ($\pm 10\%$)		.. ICR 1-1515-N ^{3,4}		.. IWR 1-1212-N ^{3,4}	
± 15	± 33	-	-	or				.. IWR 1-1515-N ^{3,4}	
5	100	5	100	24 ($\pm 10\%$)	-	-	03	.. IWR 1-05-05-N	
5	100	12	40	or	-	-		.. IWR 1-05-12-N	
5	100	15	33	28 ($\pm 10\%$)	-	-		.. IWR 1-05-15-N	
12	40	12	40	or	08	.. ICR 1-12-12-N ^{3,4}		.. IWR 1-12-12-N ^{3,4}	
15	33	15	33	48 ($\pm 10\%$) ⁵		.. ICR 1-15-15-N ^{3,4}		.. IWR 1-15-15-N ^{3,4}	
± 5	± 50	± 5	± 50		-	-	05	.. IWR 1-2x0505-N	
± 12	± 20	± 12	± 20		-	-		.. IWR 1-2x1212-N ^{3,4}	T
± 15	± 17	± 15	± 17		-	-		.. IWR 1-2x1515-N ^{3,4}	

Table 1b: Type survey IXR 1 and IYR 1

Output 1 ¹		Output 2		Input Voltage ¹	Group ²	3530 V DC/2500 V _{rms} Isolation test voltage Type ¹	Group ²	5300 V DC/3750 V _{rms} Isolation test voltage Type ¹	Option
$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	U_i [V DC]					
5	200	-	-	5 ($\pm 5\%$)	11	.. IXR 1-05-N	11	.. IYR 1-05-N	T, S
12	80	-	-	or		.. IXR 1-12-N		.. IYR 1-12-N	
15	66	-	-	12 ($\pm 10\%$)		.. IXR 1-15-N		.. IYR 1-15-N	
± 5	± 50	-	-	or	12	.. IXR 1-0505-N	12	.. IYR 1-0505-N	
± 12	± 40	-	-	15 ($\pm 10\%$)		.. IXR 1-1212-N ^{3,4}		.. IYR 1-1212-N ^{3,4}	
± 15	± 33	-	-	or		.. IXR 1-1515-N ^{3,4}		.. IYR 1-1515-N ^{3,4}	
5	100	5	100	24 ($\pm 10\%$)	13	.. IXR 1-05-05-N	13	.. IYR 1-05-05-N	
5	100	12	40	or		.. IXR 1-05-12-N		.. IYR 1-05-12-N	
5	100	15	33	28 ($\pm 10\%$)		.. IXR 1-05-15-N		.. IYR 1-05-15-N	
12	40	12	40	or		.. IXR 1-12-12-N ^{3,4}		.. IYR 1-12-12-N ^{3,4}	
15	33	15	33	48 ($\pm 10\%$) ⁵		.. IXR 1-15-15-N ^{3,4}		.. IYR 1-15-15-N ^{3,4}	

Table 1c: Type survey IZR 1

Output 1 ¹		Output 2		Input Voltage ¹	Group ²	Isolation test voltage 7070 V DC/5000 V _{rms} Type ¹	Option
$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	$U_o \text{ nom}$ [V DC]	$I_o \text{ nom}$ [mA]	U_i [V DC]			
5	200	-	-	5 ($\pm 5\%$)	11	.. IZR 1-05-N	T, S
12	80	-	-	or		.. IZR 1-12-N	
15	66	-	-	12 ($\pm 10\%$)		.. IZR 1-15-N	
± 5	± 50	-	-	or	12	.. IZR 1-0505-N	
± 12	± 40	-	-	15 ($\pm 10\%$)		.. IZR 1-1212-N ^{3,4}	
± 15	± 33	-	-	or		.. IZR 1-1515-N ^{3,4}	
5	100	5	100	24 ($\pm 10\%$)	13	.. IZR 1-05-05-N	
5	100	12	40	or		.. IZR 1-05-12-N	
5	100	15	33	28 ($\pm 10\%$)		.. IZR 1-05-15-N	
12	40	12	40	or		.. IZR 1-12-12-N ^{3,4}	
15	33	15	33	48 ($\pm 10\%$) ⁵		.. IZR 1-15-15-N ^{3,4}	

¹ The required input voltage value (e.g. 24 V) should be added to the type designation: .. ICR 1-1212-N changes to 24 ICR 1-1212-N² See Block Diagrams³ The output current of one output may be increased by 25% if the output current of the other output is reduced by 25% simultaneously. Example for a 5 IWR 1-1515-N: The +15 V output current of 33 mA may be increased to 41 mA if the -15 V output current is reduced to 25 mA.⁴ The output current of both outputs of the 12, 24, 28 and 48 V input types may be increased by 20% of $I_o \text{ nom}$. Note³ is applicable at the same time. Example for a 24 IWR 1-2x1212-N: $I_{o1} = +29 \text{ mA}/-19 \text{ mA}$, $I_{o2} = +19 \text{ mA}/-29 \text{ mA}$ or $I_{o1} = \pm 19 \text{ mA}$, $I_{o2} = \pm 29 \text{ mA}$ ⁵ Only standard temperature range N or option T available

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Electrical Input and Output Data

General Conditions: $T_A = 25^{\circ}\text{C}$

Table 2: Input Data

Input				5 V	12 V	15 V	24 V	28 V	48 V	Unit
Characteristics			Conditions							
U_i	Input voltage range	min nom max	DC	4.75 5 5.25	10.8 12 13.2	13.5 15 16.5	21.6 24 26.4	25.2 28 30.8	43.2 48 52.8	V
I_o	No load input current	typ max		85 110	35 45	30 40	15 23	17 20	8 12	mA
$U_{i\text{rfi}}$	RFI voltage at the input	typ	$U_{i\text{nom}}, I_o\text{ nom}$ $L_{\text{source}} \approx 1\text{ }\mu\text{H}$	50	80	85	100	130	200	mV _{pp}
$I_{i\text{rfi}}$	RFI current at the input	typ		10						mA _{pp}
$U_{i\text{abs}}$	Input voltage limits without any damage	min max	max 60 s	0 6.25	0 15	0 18.75	0 30	0 35	0 60	V
f_s	Switching frequency	typ		25						kHz

Table 3: Output Data

Output				5 V		12 V		15 V			
Characteristics			Conditions							Unit	
U_o	Output voltage		$U_{i\text{ nom}}, I_o\text{ nom}$	5		12		15		V	
$\Delta U_{o\text{ a}}$	Output voltage accuracy	typ max		± 1 ± 3		± 2 ± 5		± 2 ± 5		%	
u_o	Output ripple, $u_o = f(U_i)$		at $U_i =$		5	12	15	24	28	48	V
		typ	(BW = 20 MHz)		25	35	40	45	50	55	mV _{pp}
$\Delta U_{o\text{ u}}$	Static line regulation	typ	$U_{i\text{ min}} \dots U_{i\text{ max}}$ $I_o\text{ nom}$		± 0.3		± 0.2		± 0.2		%
$\Delta U_{o\text{ l}}$	Static load regulation	typ	$U_{i\text{ nom}}$ $I_o = 0 \dots I_o\text{ nom}$		± 0.8		± 0.1		± 0.1		
α_{U_o}	Temperature coefficient		$U_{i\text{ nom}}, I_o\text{ nom}$		± 0.02						%/K
$C_{o\text{ ext}}$	Maximum admissible capacitive load				22		10		10		μF

Table 4: Efficiency

Efficiency				5 V	12 V	15 V	Unit
Characteristics			Conditions				
η	Efficiency	min typ	$U_{i\text{ nom}}, I_o\text{ nom}$	50 58			%

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Supplementary Data

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 5: Isolation test voltage, coupling capacitance, insulation resistance, clearance and creepage distances

Characteristics	Conditions	ICR	IWR ¹	IXR	IYR	IZR	Unit
$U_{is\ io}$ Isolation test voltage Input to output	AC: 50 Hz,	500	1060	2500	3750	5000	V_{rms}
	1 minute	1400	3000	7070	10600	14100	V_{pp}
	DC: 1 second ²	700	1500	3530	5300	7070	V
	DC: 1 second ³	800	1700	4000	6000	8000	V
$U_{is\ oo}$ Isolation test voltage output to output ⁴	AC: 50 Hz,	500	1060	1060	1060	1060	V_{rms}
	1 minute	1400	3000	3000	3000	3000	V_{pp}
	DC: 1 second ²	700	1700	1500	1500	1500	V
	DC: 1 second ³	800	1500	1700	1700	1700	V
C_{io} Coupling capacitance typ		20	10	10	10	10	pF
R_{is} Insulation resistance	at 100 V DC after 1 minute	≥ 1000					M Ω
d_o Clearance and creepage distances input to output		≥ 0.6	≥ 1	$\geq 3^5$	$\geq 3^5$	$\geq 3^5$	mm

¹ According to EN 41003 (1993)

² For production test purposes in accordance with IEC 950/EN 60950

³ Factory test procedure

⁴ Groups 03, 05, 08 and 13

⁵ In combination with the high isolation strength of the potting compound, isolation test voltages mentioned are guaranteed.

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.

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.

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)

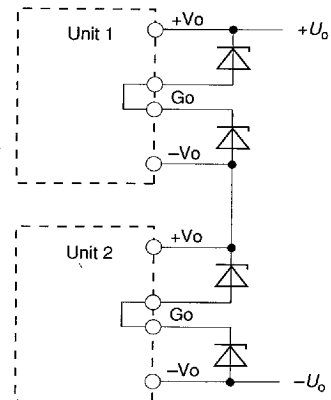


Fig. 1
Outputs connected in series

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

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Immunity to Environmental Conditions

Thermal Considerations

Table 6: Temp. specification values given are valid for air pressures in the range 800...1200 hPa (800...1200 mbar)

Characteristics		Conditions	Standard -N		Option -T		Option -S		Unit
			min	max	min	max	min	max	
T_A	Ambient temperature	$U_i \text{ min} \dots U_i \text{ max}$	0	71	-25	71	-40	85	°C
T_C	Case temperature	$I_o = 0 \dots I_o \text{ nom}$	0	91	-25	91	-40	105	
T_S	Storage temperature	not operational			-55	105			

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 $T_{C \text{ max}}$!

Table 7: 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	7'400'000	3'200'000	260'000	880'000	60'000	h
	Double and dual outputs	5'700'000	2'500'000	200'000	670'000	45'000	

Block Diagrams

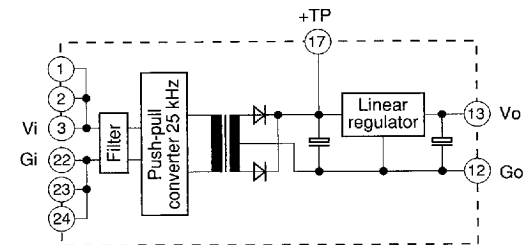


Fig. 2
IWR, group 01

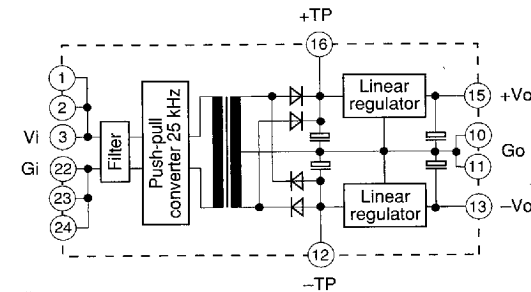


Fig. 3
IWR, group 02

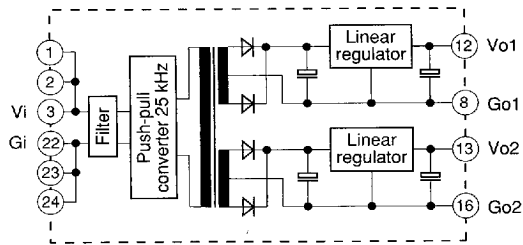


Fig. 4
IWR, group 03

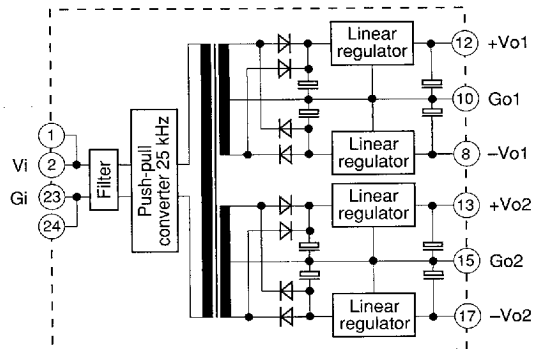


Fig. 5
IWR, group 05

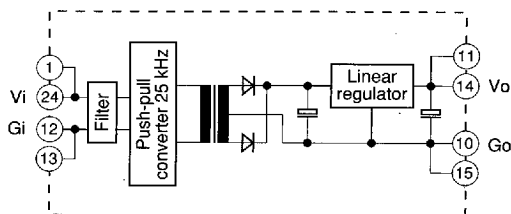


Fig. 6
ICR, group 06

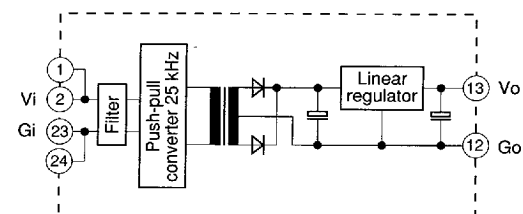


Fig. 9
IXR, IYR, IZR, group 11

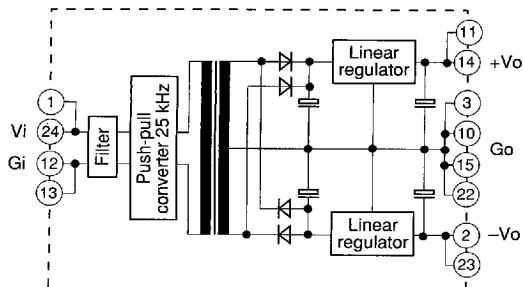


Fig. 7
ICR, group 07

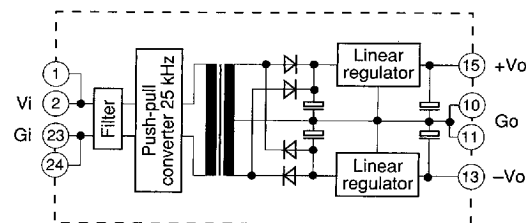


Fig. 10
IXR, IYR, IZR, group 12

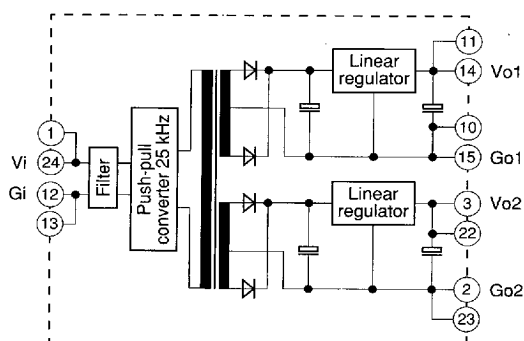


Fig. 8
ICR, group 08

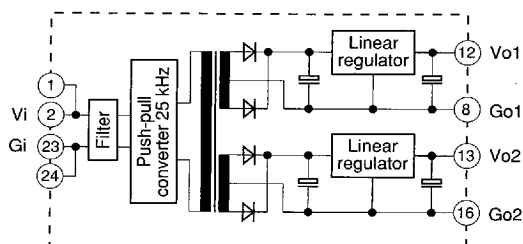


Fig. 11
IXR, IYR, IZR, group 13

Mechanical Data

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

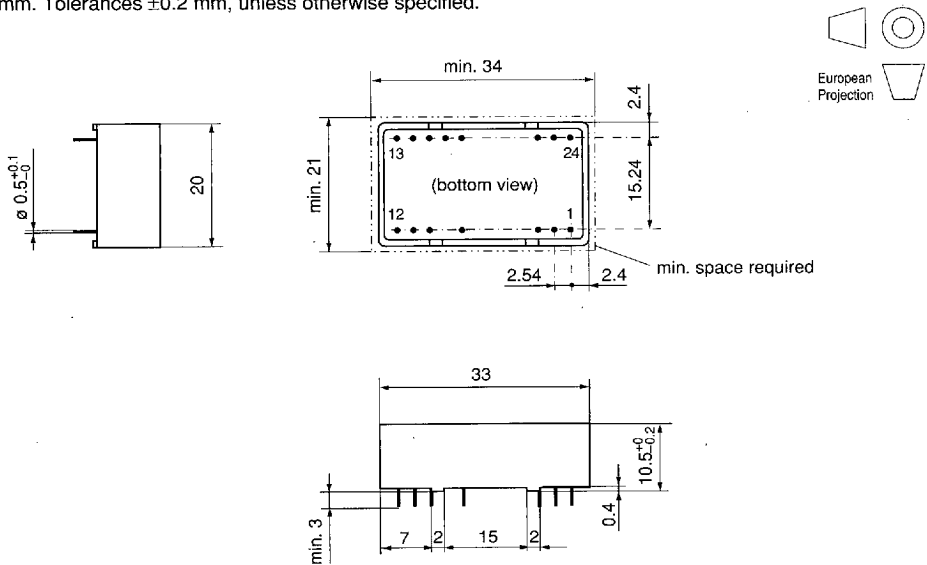


Fig. 12
Case: DIL 24. Foot print shown for all pin configurations.
Hole diameter required in PCB: $0.8^{+0.1}_{-0}$ mm
Weight: 13 g

Pin Configuration

Table 8: Pin configuration

Type	Group	1	2	3	8	10	11	12	13	14	15	16	17	22	23	24
IWR	01	Vi	Vi	Vi	-	-	-	Go	Vo	-	-	-	+TP	Gi	Gi	Gi
IWR	02	Vi	Vi	Vi	-	Go	Go	-TP	-Vo	-	+Vo	+TP	-	Gi	Gi	Gi
IWR	03	Vi	Vi	Vi	Go1	-	-	Vo1	Vo2	-	-	Go2	-	Gi	Gi	Gi
IWR	05	Vi	Vi	-	-Vo1	Go1	-	+Vo1	+Vo2	-	Go2	-	-Vo2	-	Gi	Gi
ICR	06	Vi	-	-	-	Go	Vo	Gi	Gi	Vo	Go	-	-	-	-	Vi
ICR	07	Vi	-Vo	Go	-	Go	+Vo	Gi	Gi	+Vo	Go	-	-	Go	-Vo	Vi
ICR	08	Vi	Go2	Vo2	-	Go1	Vo1	Gi	Gi	Vo1	Go1	-	-	Vo2	Go2	Vi
IXR, IYR, IZR	11	Vi	Vi	-	-	-	-	Go	Vo	-	-	-	-	-	Gi	Gi
IXR, IYR, IZR	12	Vi	Vi	-	-	Go	Go	-	-Vo	-	+Vo	-	-	-	Gi	Gi
IXR, IYR, IZR	13	Vi	Vi	-	Go1	-	-	Vo1	Vo2	-	-	Go2	-	-	Gi	Gi

Type Key and Product Marking

Type Key:

Nominal input voltage in volt

Family

Nominal output power in watt

Nominal output voltage for output 1 in volt

Dash: Designates dual output unit with two independent,
galvanically isolated outputs

Nominal output voltage for output 2 in volt

Operating ambient temperature range T_A

5

IXR

1

-

12

-

12

-

N

Nominal input voltage in volt

Family

Nominal output power in watt

Two independent, galvanically isolated double ($\pm$) outputs

Nominal output voltages in volt
for double ($\pm$) output 1 and double ($\pm$) output 2

Operating ambient temperature range T_A

24

IWR

1

-

2x

0505

-

T

Product Marking:

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

5975062 0000723 979