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).

Type Survey

General Condition: T_A = 25°C

Table 1a: Type survey ICR 1 and IWR 1

Output 1 $U_{o\,nom}$ [V DC]	Output 1 $I_{o\,nom}$ [mA]	Output 2 $U_{o\,nom}$ [V DC]	Output 2 $I_{o\,nom}$ [mA]	Input Voltage [1] U_i [V DC]	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
5	200	-	-	5 (±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 (±10%)		.. ICR 1-15-N		.. IWR 1-15-N	
±5	±50	-	-	or	-	-	02	.. IWR 1-0505-N	
±12	±40	-	-	15 (±10%)	07	.. ICR 1-1212-N [3 4]		.. IWR 1-1212-N [3 4]	
±15	±33	-	-	or		.. ICR 1-1515-N [3 4]		.. IWR 1-1515-N [3 4]	
5	100	5	100	24 (±10%)	-	-	03	.. IWR 1-05-05-N	
5	100	12	40	or	-	-		.. IWR 1-05-12-N	
5	100	15	33	28 (±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 (±10%) [5]		.. ICR 1-15-15-N [3 4]		.. IWR 1-15-15-N [3 4]	
±5	±50	±5	±50		-	-	05	.. IWR 1-2×0505-N	T
±12	±20	±12	±20		-	-		.. IWR 1-2×1212-N [3 4]	
±15	±17	±15	±17		-	-		.. IWR 1-2×1515-N [3 4]	

Table 1b: Type survey IXR 1 and IYR 1

Output 1 $U_{o\,nom}$ [V DC]	Output 1 $I_{o\,nom}$ [mA]	Output 2 $U_{o\,nom}$ [V DC]	Output 2 $I_{o\,nom}$ [mA]	Input Voltage [1] U_i [V DC]	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
5	200	-	-	5 (±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 (±10%)		.. IXR 1-15-N		.. IYR 1-15-N	
±5	±50	-	-	or	12	.. IXR 1-0505-N		.. IYR 1-0505-N	
±12	±40	-	-	15 (±10%)		.. IXR 1-1212-N [3 4]	12	.. 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 (±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 (±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 (±10%) [5]		.. IXR 1-15-15-N [3 4]		.. IYR 1-15-15-N [3 4]	

Table 1c: Type survey IZR 1

Output 1 $U_{o\,nom}$ [V DC]	Output 1 $I_{o\,nom}$ [mA]	Output 2 $U_{o\,nom}$ [V DC]	Output 2 $I_{o\,nom}$ [mA]	Input Voltage [1] U_i [V DC]	Group [2]	7070 V DC/5000 V_{rms} Isolation test voltage Type [1]	Option
5	200	-	-	5 (±5%)	11	.. IZR 1-05-N	T, S
12	80	-	-	or		.. IZR 1-12-N	
15	66	-	-	12 (±10%)		.. IZR 1-15-N	
±5	±50	-	-	or	12	.. IZR 1-0505-N	
±12	±40	-	-	15 (±10%)		.. IZR 1-1212-N [3 4]	
±15	±33	-	-	or		.. IZR 1-1515-N [3 4]	
5	100	5	100	24 (±10%)	13	.. IZR 1-05-05-N	
5	100	12	40	or		.. IZR 1-05-12-N	
5	100	15	33	28 (±10%)		.. IZR 1-05-15-N	
12	40	12	40	or		.. IZR 1-12-12-N [3 4]	
15	33	15	33	48 (±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-N
[2] See Block Diagrams
[3] 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 $I_{o\,nom}$. Note [3] is applicable at the same time. Example for a 24 IWR 1-2×1212-N: I_{o1} = +29 mA/–19 mA, I_{o2} = +19 mA/–29 mA or I_{o1} = ±19 mA, I_{o2} = ±29 mA
[5] Only standard temperature range N or option T available

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 DC 60 V).

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
	Double or reinforced	≤60 V	SELV circuit	Operational	SELV circuit

[1] The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC 950.

Immunity to Environmental Conditions

6.1

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 -N		Option -T		Option -S		Unit
			min	max	min	max	min	max	
T_A	Ambient temperature	$U_{i\,min}...U_{i\,max}$ $I_o = 0...I_{o\,nom}$	0	71	–25	71	–40	85	°C
T_C	Case temperature		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 $T_{C\,max}$!

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	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	

Electrical Input and Output Data

General Condition: 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	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
$I_{i\,o}$	No load input input current	typ max	$U_{i\,nom}$, I_o = 0	85 110	35 45	30 40	15 23	17 20	8 12	mA
$u_{i\,rfi}$	RFI voltage at the input	typ	$U_{i\,nom}$, $I_{o\,nom}$ $L_{source} \approx 1\ \mu H$	50	80	85	100	130	200	mV_{pp}
$i_{i\,rfi}$	RFI current at the input	typ		10						mA_{pp}
$U_{i\,abs}$	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	$U_{i\,nom}$, $I_{o\,nom}$	25						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	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}
$\Delta U_{o\,U}$	Static line regulation	typ	$U_{i\,min}$…$U_{i\,max}$ $I_{o\,nom}$	±0.3		±0.2		±0.2		%
$\Delta U_{o\,I}$	Static load regulation	typ	$U_{i\,nom}$ I_o = 0…$I_{o\,nom}$	±0.8		±0.1		±0.1		
α_{Uo}	Temperature coefficient		$U_{i\,nom}$, $I_{o\,nom}$	±0.02						%/K
$C_{o\,ext}$	Maximum admissible capacitive load			22		10		10		µF

Table 7: Efficiency

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

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, 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, 1 minute	500	1060	2500	3750	5000	V_{rms}
			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	
$U_{is\ oo}$	Isolation test voltage output to output [4]	AC: 50 Hz, 1 minute	500	1060	1060	1060	1060	V_{rms}
			1400	3000	3000	3000	3000	V_{pp}
		DC: 1 second [2]	700	1500	1500	1500	1500	V
		DC: 1 second [3]	800	1700	1700	1700	1700	
C_{io}	Coupling capacitance typ		20	10	10	10	10	pF
R_{is}	Insulation resistance	at 100 V DC after 1 minute	≥1000					MΩ
d_{io}	Clearance and creepage distances input to output		≥0.6	≥1	≥3 [5]	≥3 [5]	≥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.

6.1

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.

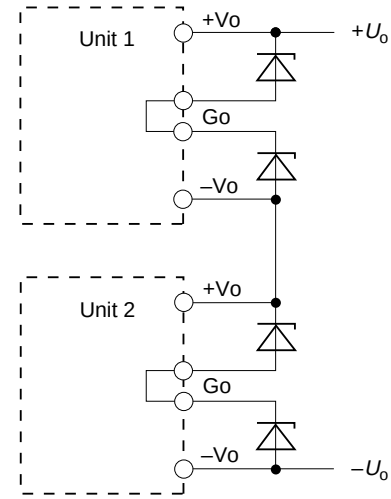


Fig. 1
Outputs connected in series

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.

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

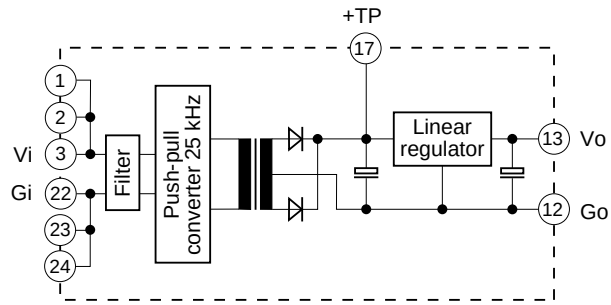


Fig. 2
IWR, group 01

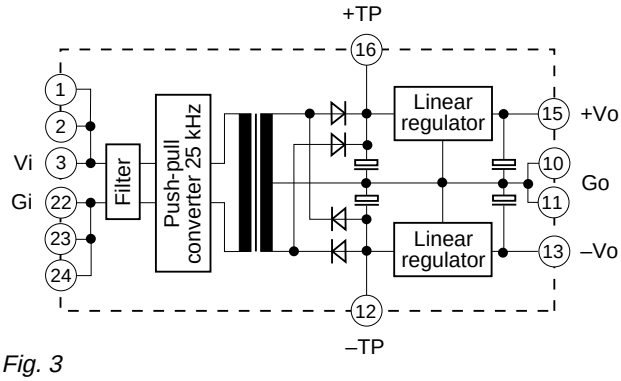


Fig. 3
IWR, group 02

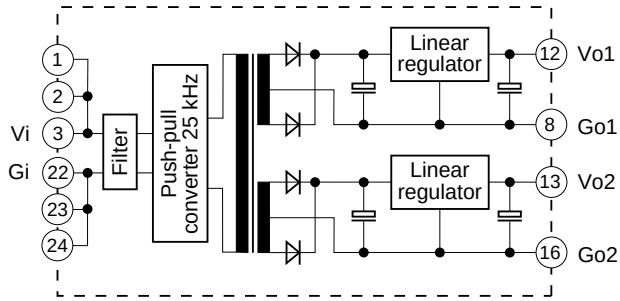


Fig. 4
IWR, group 03

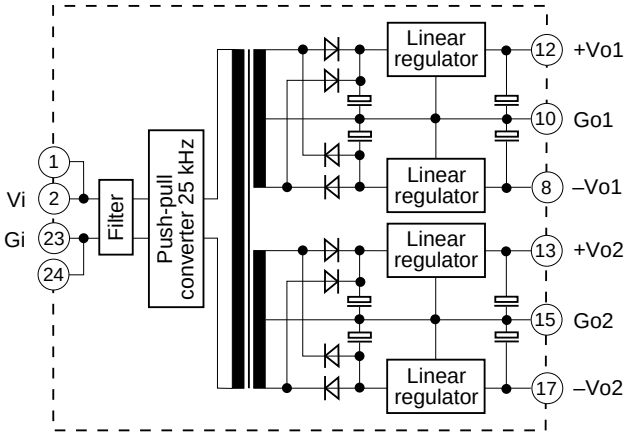


Fig. 5
IWR, group 05

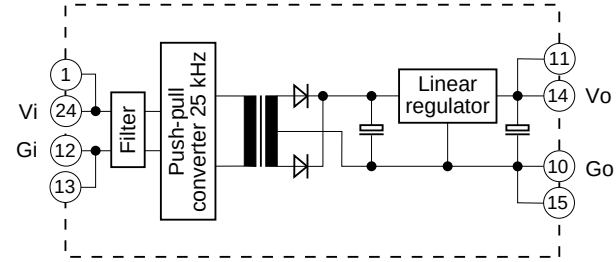


Fig. 6
ICR, group 06

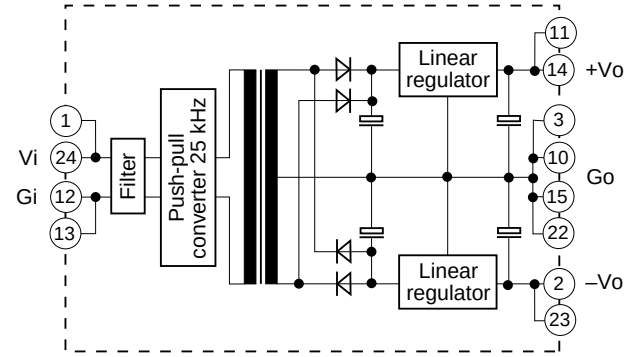


Fig. 7
ICR, group 07

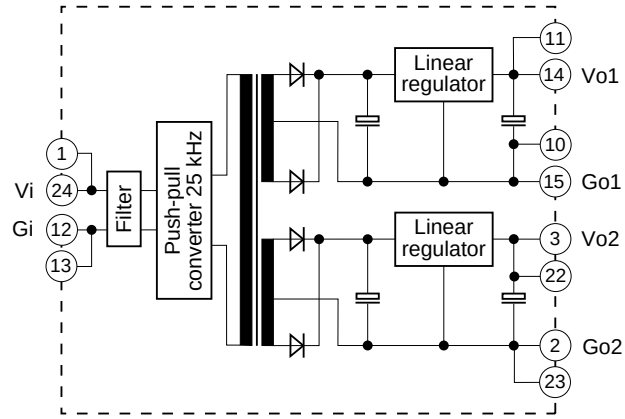


Fig. 8
ICR, group 08

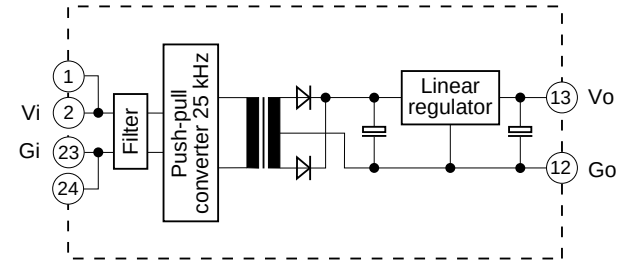


Fig. 9
IXR, IYR, IZR, group 11

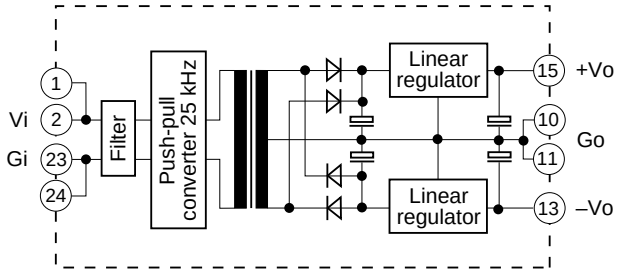


Fig. 10
IXR, IYR, IZR, group 12

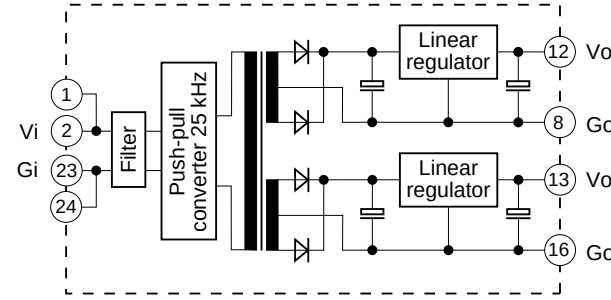


Fig. 11
IXR, IYR, IZR, group 13

Pin Configuration

Table 9: 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

Mechanical Data

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

European Projection

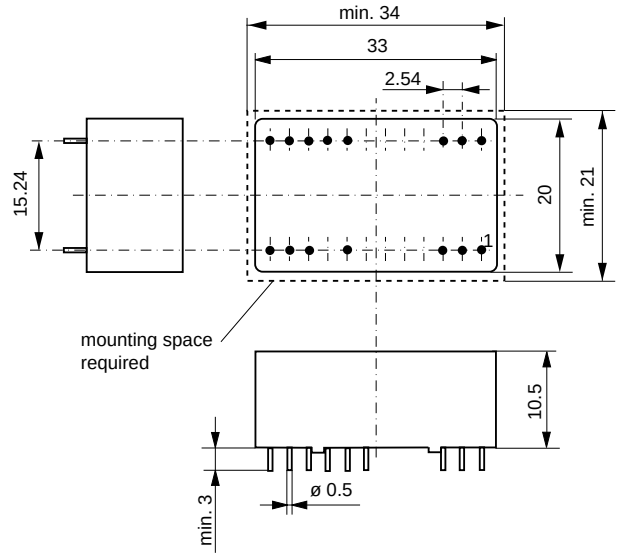
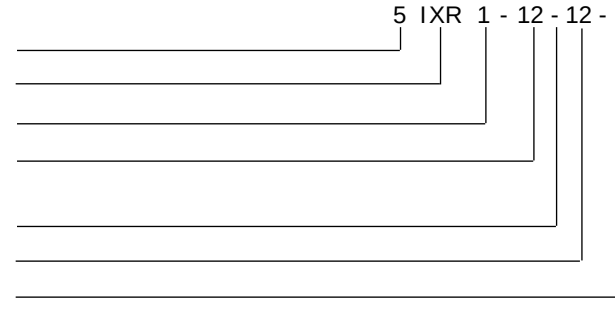


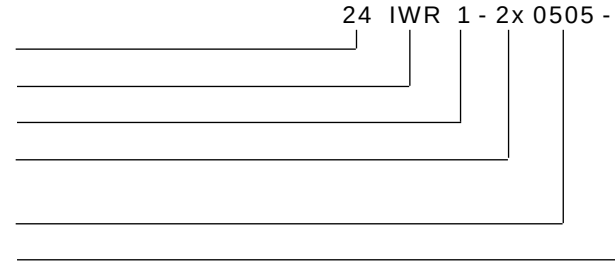
Fig. 12
Case: DIL 24. Foot print shown for all pin configurations.
Hole diameter required in PCB: 0.8 ±0.1 mm
Weight: 13 g

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 double output unit with two independent, galvanically isolated outputs .....
Nominal output voltage for output 2 in volt .....
Operating ambient temperature range T_A .....



Nominal input voltage in volt .....
Family .....
Nominal output power in watt .....
Two independent, galvanically isolated double (±) outputs
Nominal output voltages in volt for dual (±) output 1 and dual (±) output 2 .....
Operating ambient temperature range T_A .....

6.1

Product Marking:

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