

IBEK DC-DC Converters

3 Watt-Family

Input to output and output to output isolation test voltage 500 V_{rms} or 1 kV_{rms}
Single, double and dual outputs
Input voltage ranges: 10...33 V DC and 18...72 V DC

- Wide input voltage ranges of up to 1:4
- Efficient current compensated input filter
- SD-shutdown input
- High efficiency (typ. 80%)
- High reliability
- No-load and short-circuit proof
- Operating ambient temperature range up to -40...85°C (optional)
- No derating
- DIL 24 package size, height only 10.5 mm

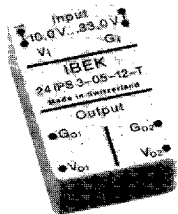


Table of Contents	Page
Description	5 - 11
Type Survey	5 - 12
Electrical Input and Output Data	5 - 13
Supplementary Data	5 - 14
Immunity to Environmental Conditions	5 - 14
Functional Description and Block Diagrams	5 - 15
Mechanical Data	5 - 16
Type Key and Product Marking	5 - 16

Description

This series of DC-DC converters has been developed for powering electronic circuits, e.g. telephone system components, control modules and small appliances. They are also suitable for applications with variable input voltages or with input transients. The converters feature high efficiency, high reliability, and good dynamic response to load changes and at start-up. Efficiency is high and practically

constant over the entire input voltage range. Two input to output isolation test voltage categories and two temperature ranges are available.
All modules are manufactured according to ISO 9001.
Case: DIL 24 package, grey coloured plastics, self cooling (free air convection).

5975062 0000724 805

Type Survey

General Condition: TA = 25°C

Table 1a: Type survey IPS 3

Output 1		Output 2		Input Voltage U_i [V DC]	Group	700 V DC/500 V _{rms} Isolation test voltage Type	Option
$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]	$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]				
5	500	-	-	24 IPS .. 10...33 (nominal 24)	01	.. IPS 3-05-T .. IPS 3-12-T .. IPS 3-15-T	S
12	250	-	-		02	.. IPS 3-0505-T .. IPS 3-1212-T .. IPS 3-1515-T	
15	200	-	-				
+5	250	-5	250	48 IPS .. 18...72 (nominal 48)	03 ¹	.. IPS 3-0505-T .. IPS 3-05-12-T .. IPS 3-05-15-T .. IPS 3-12-12-T .. IPS 3-15-15-T	
+12	125	-12	125				
+15	100	-12	100				
5	250	5	250	48 IPS .. 18...72 (nominal 48)	03 ¹	.. IPS 3-0505-T .. IPS 3-05-12-T .. IPS 3-05-15-T .. IPS 3-12-12-T .. IPS 3-15-15-T	
5	250	12	125				
5	250	15	100				
12	125	12	125				
15	100	15	100				

Table 1b: Type survey CPS 3

Output 1		Output 2		Input Voltage U_i [V DC]	Group	700 V DC/500 V _{rms} Isolation test voltage Type	Option
$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]	$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]				
5	500	-	-	24 CPS .. 10...33 (nominal 24)	04 ²	.. CPS 3-05-T .. CPS 3-12-T .. CPS 3-15-T	S
12	250	-	-		05 ²	.. CPS 3-0505-T .. CPS 3-1212-T .. CPS 3-1515-T	
15	200	-	-				
+5	250	-5	250	48 CPS .. 18...72 (nominal 48)	05 ²	.. CPS 3-0505-T .. CPS 3-1212-T .. CPS 3-1515-T	
+12	125	-12	125				
+15	100	-12	100				

Table 1c: Type survey IPW 3

Output 1		Output 2		Input Voltage U_i [V DC]	Group	1500 V DC/1060 V _{rms} Isolation test voltage Type	Option
$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]	$U_{o \text{ nom}}$ [V DC]	$I_{o \text{ nom}}$ [mA]				
5	500	-	-	24 IPW .. 10...33 (nominal 24)	01	.. IPW 3-05-T .. IPW 3-12-T .. IPW 3-15-T	S
12	250	-	-		02	.. IPW 3-0505-T .. IPW 3-1212-T .. IPW 3-1515-T	
15	200	-	-				
+5	250	-5	250	48 IPW .. 18...72 (nominal 48)	03 ¹	.. IPW 3-0505-T .. IPW 3-05-12-T .. IPW 3-05-15-T .. IPW 3-12-12-T .. IPW 3-15-15-T	
+12	125	-12	125				
+15	100	-12	100				
5	250	5	250				
5	250	12	125				
5	250	15	100				
12	125	12	125				
15	100	15	100				

¹ Group 03 features two independent galvanically isolated outputs. For each unit, the output to output isolation test voltage is identical to that for input to output isolation.

² See Mechanical Data: "Alternative Pin Configuration"

Other types with different input and output specifications available upon request.

5975062 0000725 741

Electrical Input and Output Data

General Conditions: $T_A = 25^{\circ}\text{C}$, unless otherwise specified

Table 2: Input Data

Input				.. IPS/IPW 3-05 ..			.. IPS/IPW 3-12 ..			.. IPS/IPW 3-15 ..			
Characteristics			Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_i	Input voltage range	24 IPS/IPW 48 IPS/IPW	$T_A \text{ min} \dots T_A \text{ max}$ $I_o = 0 \dots I_o \text{ nom}$	10	33		10	33		10	33		V DC
				18	72		18	72		18	72		
$U_{i \text{ abs}}$	Input voltage limits without any damage	24 IPS/IPW ¹ 48 IPS/IPW ²		0	45		0	45		0	45		
				0	75		0	75		0	75		
I_o	No load input current		$U_i \text{ nom} = 24 \text{ V}, I_o = 0$ $U_i \text{ nom} = 48 \text{ V}, I_o = 0$	5			5			5			mA
				3			3			3			
I_{SD}	Input current in shutdown condition		$U_i \text{ min} \dots U_i \text{ max}$ $T_A \text{ min} \dots T_A \text{ max}$	1.3			1.3			1.3			
I_L	Input current limitation response		$U_i \text{ min} \dots U_i \text{ max}$ $T_A \text{ min} \dots T_A \text{ max}$	1.25 $I_{i \text{ max}}$			1.25 $I_{i \text{ max}}$			1.25 $I_{i \text{ max}}$			
I_{rfi}	RFI current at the input		$I_o = 0 \dots I_o \text{ max}$	30			30			30			mA_{pp}
U_{SD}	Shutdown voltage for converter		operating not operating	open or 8...10 -0.3...+2			open or 8...10 -0.3...+2			open or 8...10 -0.3...+2			V DC
I_{SD}	Shutdown current for converter		operating not operating	+1...+5 -25...-35			+1...+5 -25...-35			+1...+5 -25...-35			μA
f_s	Switching frequency		$U_i \text{ min} \dots \text{max}, I_o \text{ nom}$ $T_A \text{ min} \dots T_A \text{ max}$	130			130			130			kHz

¹ 35 V DC for 500 ms, repetition rate 50 s; 45 V DC for 10 ms repetition rate 10 s; according to Siemens standard SN 26555, section 9
² The applied minimum load must be 25% between 72.0...75.0 V DC

Table 3: Output Data

Output				.. IPS/IPW 3-05 ..			.. IPS/IPW 3-12 ..			.. IPS/IPW 3-15 ..			
Characteristics			Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_o	Output voltage		$U_i \text{ nom}, I_o \text{ nom}$	4.90	5.10		11.76	12.24		14.70	15.30		V DC
$I_o \text{ nom}$	Nominal output current	Group 01 Group 02/03	$U_i \text{ min} \dots U_i \text{ max}$ $T_A \text{ min} \dots T_A \text{ max}$	500			250			200			mA
				250			125			100			
u_o	Output ripple (BW = 20 MHz)		$U_i \text{ min} \dots U_i \text{ max}$ $I_o \text{ nom}$	100			100			100			mV_{pp}
ΔU_{oU}	Static line regulation			± 10			± 12			± 15			mV
ΔU_{oI}	Static load regulation		$U_i \text{ min} \dots U_i \text{ max}$ $I_o \text{ nom} \dots 0.25 I_o \text{ nom}$	0...5			0...2 ¹			0...2 ¹			%
α_{Uo}	Temperature coefficient		$U_i \text{ nom}, I_o \text{ nom}$	± 0.02			± 0.02			± 0.02			%/K
	Output overvoltage clamping			5.6 +5/-0%			13 +5/-0%			16 +5/-0%			V
$C_{o \text{ ext}}$	Maximum admissible capacitive load			33			15			15			μF

¹ 0...5% for the galvanically isolated second output of the types ..05-12.. and ..05-15..
Double and dual output units should have the same (%) load conditions at both outputs to comply with above specifications

Table 4: Efficiency

Efficiency				.. IPS/IPW 10-05 ..			.. IPS/IPW 10-12 ..			.. IPS/IPW 10-15 ..			
Characteristics			Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
η	Efficiency		$U_i \text{ nom} = 24 \text{ V}, I_o \text{ nom}$ $U_i \text{ nom} = 48 \text{ V}, I_o \text{ nom}$	78	80		78	80		78	80		%
				80	82		80	82		80	82		

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 and insulation resistance

Characteristics	Conditions	IPS	IPW 1	Unit
U_{iso} Isolation test voltage Input to output	AC: 50 Hz, 1 minute	500	1060	V_{rms}
	DC: 1 second ²	1400	3000	V_{pp}
	DC: 1 second ²	700	1500	V
	DC: 1 second ³	800	1700	
U_{iso} Isolation test voltage output to output ⁴	AC: 50 Hz, 1 minute	500	1060	V_{rms}
	DC: 1 second ²	1400	3000	V_{pp}
	DC: 1 second ²	700	1500	V
	DC: 1 second ³	800	1700	
C_{io} Coupling capacitance	typ	300	external ⁵	pF
R_{is} Insulation resistance	at 100 V DC after 1 minute	≥ 2000		M Ω

¹ According to EN 41003 (1993) ² For production test purposes in accordance with IEC 950/EN 60950 ³ Factory test procedure

⁴ Group 03 ⁵ Important: All IPW types need (an) external coupling capacitor(s) C_{io} of min. 220 pF, 1 kV_{rms}

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 (5 V), BZW04-11 (12 V), BZW04-14 (15 V) 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)

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

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 -T		Option -S		Unit
			min	max	min	max	
T_A	Ambient temperature	$U_{\min} \dots U_{\max}$	0	71	-40	85	°C
T_C	Case temperature	$I_b = 0 \dots I_{b\text{ nom}}$	0	91	-40	105	
T_S	Storage temperature	not operational	-55	105	-55	105	

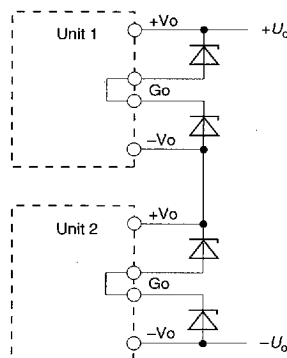


Fig. 1
Outputs connected in series

Shutdown Description

The shutdown terminal is used to switch the converter output voltage U_o on and off via a control signal (e.g. using an open collector drive). See "Electrical Input and Output Data".

The output voltage is switched on when the shutdown terminal is open circuit or +8...+10 V. The output voltage is switched off when a voltage of -0.3...+2 V is applied to the shutdown terminal. At the open shutdown pin 10...12 V will appear.

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

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	Group 01	2'900'000	1'400'000	310'000	430'000	150'000	h
	Group 02/03	2'300'000	1'000'000	270'000	310'000	110'000	

Functional Description and Block Diagrams

These converters are primary controlled flyback converters using Pulse With Modulation (PWM). The output voltage is monitored via a separate transformer winding very close to the secondary winding(s) and fed back to the control circuit.

This is the reason why double and dual output units should always have the same (%) load conditions at both outputs to comply with the specified data. The current limitation is located on the primary side, limiting the total output current.

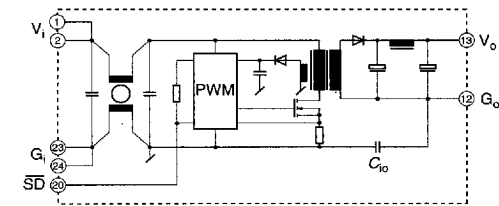


Fig. 2
IPS 3, Group 01

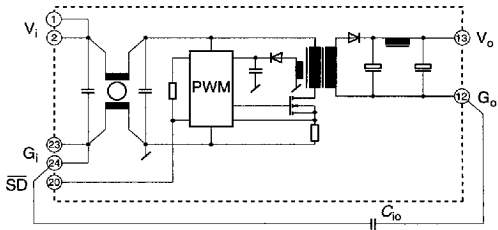


Fig. 5
IPW 3, Group 01, external C_{10} is required

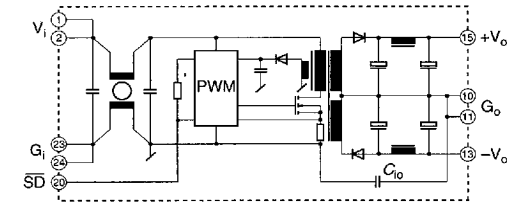


Fig. 3
IPS 3, Group 02

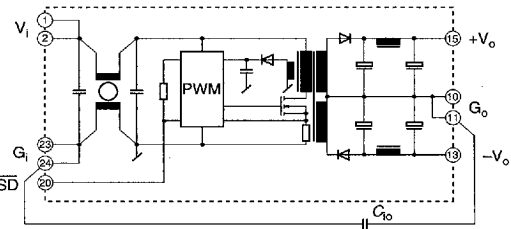


Fig. 6
IPW 3, Group 02, external C_{10} is required

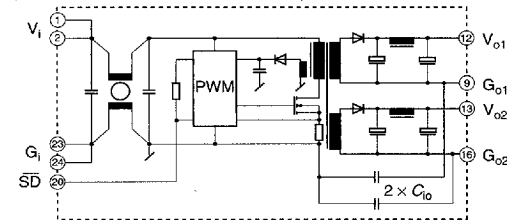


Fig. 4
IPS 3, Group 03

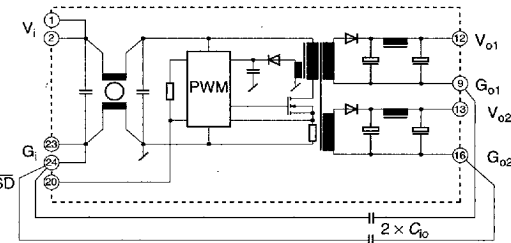


Fig. 7
IPW 3, Group 03, external $2 \times C_{10}$ is required

Mechanical Data

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

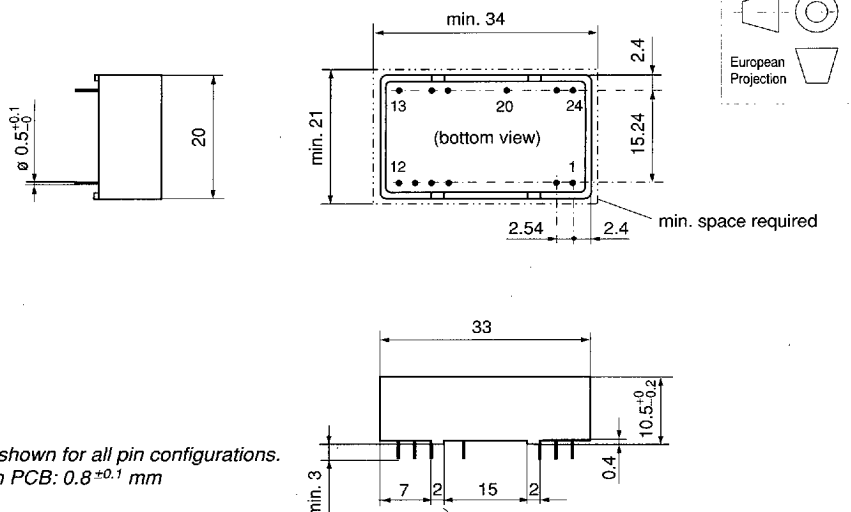


Fig. 8

Case: DIL 24. Foot print shown for all pin configurations.

Hole diameter required in PCB: 0.8 ± 0.1 mm

Weight: 15 g

Pin Configuration

Table 8: Pin configuration

Group	1	2	9	10	11	12	13	15	16	20	23	24
01	Vi	Vi	-	-	-	Go	Vo	-	-	SD	Gi	Gi
02	Vi	Vi	-	Go	Go	-	-Vo	+Vo	-	SD	Gi	Gi
03	Vi	Vi	Go1	-	-	Vo1	Vo2	-	Go2	SD	Gi	Gi

Table 9: Alternative pin configuration

Group	1	2	9	10	11	12	13	16	20	22	23	24
04	-	Gi	Gi	-	-	-	Vo	Go	-	Vi	Vi	-
05	-	Gi	Gi	Go	-Vo	-	+Vo	Go	-	Vi	Vi	-

The converters of groups 04 and 05 are designated as CPS 3 types. The type variety and all specifications are the same as for the IPS 3 group 01 and 02 with the exception of the shutdown function which is not available.

Type Key and Product Marking

Type Key:

Nominal input voltage in volt 24, 48

Family IPS, IPW, CPS

Nominal output power in watt 3

Nominal output voltage for output 1 in volt 05, 12, 15

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

Nominal output voltage for output 2 in volt 05, 12, 15

Operating ambient temperature range T_A
$$T_A = -25 \dots 71^\circ\text{C} \dots\dots\dots -T$$
$$T_A = -40 \dots 85^\circ\text{C} \dots \dots \dots -S$$

Product Marking:

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

Bottom: Date code.

5975062 0000729 397