IBEK DC-DC Converters

10 Watt-Family

Input to output isolation test voltage up to 5 kV_{rms}
1 or 2 Outputs: IPS 10, IPW 10, IPZ 5
Input voltage ranges: 10...33 V DC and 18...72 V DC

- Extremely high isolation test voltages
- Wide input voltage ranges of up to 1:4
- Efficient input Pi-filter
- SD-shutdown input (on request)
- High efficiency (typ. 80%)
- High reliability
- Continuous no-load and short-circuit proof
- Case height only 10.5 mm

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Description

This series of DC-DC converters has been developed for powering electronic circuits and systems, e.g. telephone system components, control modules and small appliances. They are also suitable for applications with variable input voltages or with input transients. Input to output isolation test voltage categories up to 5 kV_{rms} are available. The converters feature high efficiency, high reliability, low output voltage ripple and excellent dynamic response. Efficiency is high and practically constant over the entire input voltage range.

All modules are manufactured according to ISO 9001.

Case: IPS/IPW: 2"× 2" metal, black anodized, IPZ: black colored plastics, self cooling (free air convection).

MELCHER
The Power Partners.

Type Survey

General Condition: T_A = 25°C

Table 1a: Type survey IPS 10

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 Range U_i [V DC]	Group [1]	700 V DC/500 V_{rms} Isolation test voltage Type [2]	Pin Configuration
5 12 15	2000 833 667	- - -	- - -	24 IPS .. 10...33 (nominal 24)	01	.. IPS 10-05-T.. .. IPS 10-12-T.. .. IPS 10-15-T..	C, B, G, F
+5 +12 +15	1000 417 333	–5 –12 –15	1000 417 333	48 IPS .. 18...72 (nominal 48)	02	.. IPS 10-0505-T.. .. IPS 10-1212-T.. .. IPS 10-1515-T..	

Table 1b: Type survey IPW 10

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 Range U_i [V DC]	Group [1]	1500 V DC/1060 V_{rms} Isolation test voltage Type [2]	Pin Configuration
5 12 15	2000 833 667	- - -	- - -	24 IPW .. 10...33 (nominal 24)	01	.. IPW 10-05-T.. .. IPW 10-12-T.. .. IPW 10-15-T..	C, G
+5 +12 +15	1000 417 333	–5 –12 –15	1000 417 333	48 IPW .. 18...72 (nominal 48)	02	.. IPW 10-0505-T.. .. IPW 10-1212-T.. .. IPW 10-1515-T..	

Table 1c: Type survey IPZ 5

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 Range U_i [V DC]	Group [1]	7070 V DC/5000 V_{rms} Isolation test voltage Type [2]	Pin Configuration
5 12 15	1000 417 333	- - -	- - -	24 IPZ .. 10...33 (nominal 24)	01	.. IPZ 5-05-T.. .. IPZ 5-12-T.. .. IPZ 5-15-T..	C
+5 +12 +15	500 208 167	–5 –12 –15	500 208 167	48 IPZ .. 18...72 (nominal 48)	02	.. IPZ 5-0505-T.. .. IPZ 5-1212-T.. .. IPZ 5-1515-T..	

[1] See Block Diagrams
[2] Nominal input voltage and pin configuration should be added to the type designation (e.g. 24 IPS 10-05-TC)

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

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.

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 [2]
		≤72 V	Unearthed hazardous voltage secondary circuit [3]	Operational	Earthed SELV circuit [1 2]
	Double or reinforced	≤60 V	SELV circuit	Operational	SELV circuit [2]
		≤72 V	Double or reinforced insulated unearthed hazardous voltage secondary circuit, supplying an SELV circuit [4]	Operational	

[1] The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC 950.
[2] The output has to be protected against overvoltages higher than 60 V by external means, e.g. an overvoltage suppressor diode.
[3] 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.
[4] 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.

6.1

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		on request [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] Available on request as special types (custom designed units) with reduced output power

The case temperature T_C should 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 outputs	1'850'000	510'000	250'000	150'000	70'000	

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

Characteristic		Conditions	IPS	IPW [1]	IPZ	Unit
$U_{is\ io}$	Isolation test voltage Input to output	AC: 50 Hz, 1 minute	500	1060	5000	V_{rms}
			1400	3000	14100	V_{pp}
		DC: 1 second [2]	700	1500	7070	V
		DC: 1 second [3]	800	1700	8000	
C_{io}	Coupling capacitance typ		1000	1000	40	pF
R_{is}	Insulation resistance	at 100 V DC after 1 minute	≥1000			MΩ

[1] According to EN 41003 (1993)
[2] For production test purposes in accordance with IEC 950/EN 60950
[3] 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 (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 air only.

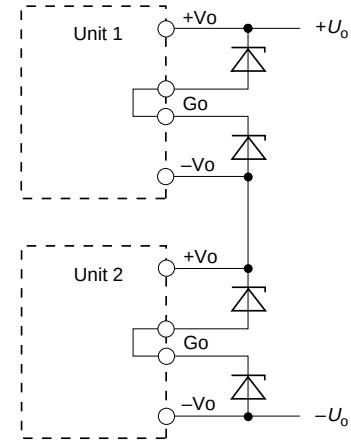


Fig. 1
Outputs connected in series

Shutdown Description

The shutdown terminal is used to switch the converter output voltage U_o on and off (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. 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.

Electrical Input and Output Data

General Conditions: T_A = 25 °C, unless otherwise specified

Table 5a: Input Data

Input			.. IPS/IPW 10-05 ..			.. IPS/IPW 10-12 ..			.. IPS/IPW 10-15 ..			
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_i	Input voltage range 24 IPS 48 IPS	$T_{A\,min}...T_{A\,max}$ I_o = 0...$I_{o\,nom}$	10 18		33 72	10 18		33 72	10 18		33 72	V DC
$U_{i\,abs}$	Input voltage limits without any damage 24 IPS [1] 48 IPS [2]		0 0		45 75	0 0		45 75	0 0		45 75	
$I_{i\,o}$	No load input current Group 01 Group 02	$U_{i\,nom}$, I_o = 0		25 25			25 45			25 45		mA
$I_{i\,SD}$ [3]	Input current in shutdown condition	$U_{i\,min}...U_{i\,max}$ $T_{A\,min}...T_{A\,max}$		3			3			3		
$I_{i\,L}$	Input current limitation response	$U_{i\,min}...U_{i\,max}$ $T_{A\,min}...T_{A\,max}$ I_o = 0...$I_{o\,nom}$		1.2 I_i			1.2 I_i			1.2 I_i		
$i_{i\,rfi}$	RFI current at the input			30			30			30		mA_{pp}
U_{SD} [3]	Shutdown voltage for converter	operating not operating		open circuit –0.3...+2			open circuit –0.3...+2			open circuit –0.3...+2		V DC
I_{SD} [3]	Shutdown current for converter	operating not operating		- 3			- 3			- 3		µA
f_s	Switching frequency	$U_{i\,min}$···$_{max}$, $I_{o\,nom}$ $T_{A\,min}...T_{A\,max}$		145			145			145		kHz

[1] 35 V 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 10% between 72.0...75.0 V DC
[3] With shutdown facility: Pin configuration F and G for IPS-types, pin configuration G for IPW-types

Table 6a: Output Data

Output			.. IPS/IPW 10-05 ..			.. IPS/IPW 10-12 ..			.. IPS/IPW 10-15 ..			
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_o	Output voltage	$U_{i\,nom}$, $I_{o\,nom}$	4.95		5.05	11.88		12.12	14.85		15.15	V DC
$I_{o\,nom}$	Nominal output current Group 01 Group 02	$U_{i\,min}$…$U_{i\,max}$ $T_{A\,min}...T_{A\,max}$		2000 1000			833 417			667 333		mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i\,min}...U_{i\,max}$ $I_{o\,nom}$		50	100		120	240		150	300	mV_{pp}
$\Delta U_{o\,U}$	Static line regulation			5	10		12	24		15	30	mV
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,min}...U_{i\,max}$ $I_{o\,nom}...0$		0...50			0...50			0...50		
α_{Uo}	Temperature coefficient	$U_{i\,nom}$, $I_{o\,nom}$			±0.02			±0.02			±0.02	%/K
	Output overvoltage clamping			5.6 +10/–0%			13 +10/–0%			16 +10/–0%		V

Table 7a: 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	$U_{i\,nom}$ = 24 V, $I_{o\,nom}$ $U_{i\,nom}$ = 48 V, $I_{o\,nom}$	77 77	80 80		77 77	80 80		77 77	80 80		%

Dual output units should have the same (%) load conditions at both outputs to comply with above specifications.

Table 5b: Input Data

Input			.. IPZ 5-05 ..			.. IPZ 5-12 ..			.. IPZ 5-15 ..			
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_i	Input voltage range 24 IPS 48 IPS	$T_{A\,min}$... $T_{A\,max}$ I_o = 0...$I_{o\,nom}$	10 18		33 72	10 18		33 72	10 18		33 72	V DC
$U_{i\,abs}$	Input voltage limits without any damage 24 IPS [1] 48 IPS [2]		0 0		45 75	0 0		45 75	0 0		45 75	
$I_{i\,o}$	No load input current Group 01 Group 02	$U_{i\,nom}$, I_o = 0		25 25			25 45			25 45		mA
$I_{i\,L}$	Input current limitation response	$U_{i\,min}$...$U_{i\,max}$ $T_{A\,min}$... $T_{A\,max}$ I_o = 0...$I_{o\,nom}$		1.2 I_i			1.2 I_i			1.2 I_i		
$i_{i\,rfi}$	RFI current at the input			30			30			30		mA_{pp}
f_s	Switching frequency	$U_{i\,min}$...$_{max}$, $I_{o\,nom}$ $T_{A\,min}$... $T_{A\,max}$		145			145			145		kHz

[1] 35 V 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 10% between 72.0...75.0 V DC

Table 6b: Output Data

Output			.. IPZ 5-05 ..			.. IPZ 5-12 ..			.. IPZ 5-15 ..			
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
U_o	Output voltage	$U_{i\,nom}$, $I_{o\,nom}$	4.95		5.05	11.88		12.12	14.85		15.15	V DC
$I_{o\,nom}$	Nominal output current Group 01 Group 02	$U_{i\,min}$...$U_{i\,max}$ $T_{A\,min}$... $T_{A\,max}$		1000 500			417 208			333 167		mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i\,min}$...$U_{i\,max}$ $I_{o\,nom}$		50	100		120	240		150	300	mV_{pp}
$\Delta U_{o\,U}$	Static line regulation			5	10		12	24		15	30	mV
$\Delta U_{o\,I}$	Static load regulation	$U_{i\,min}$...$U_{i\,max}$ $I_{o\,nom}$...0		0...50			0...50			0...50		
α_{Uo}	Temperature coefficient	$U_{i\,nom}$, $I_{o\,nom}$			±0.02			±0.02			±0.02	%/K
	Output overvoltage clamping			5.6 +10/–0%			13 +10/–0%			16 +10/–0%		V

Table 7b: Efficiency

Efficiency			.. IPZ 5-05 ..			.. IPZ 5-12 ..			.. IPZ 5-15 ..			
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	Unit
η	Efficiency	$U_{i\,nom}$ = 24 V, $I_{o\,nom}$ $U_{i\,nom}$ = 48 V, $I_{o\,nom}$	77 77	80 80		77 77	80 80		77 77	80 80		%

Dual output units should have the same (%) load conditions at both outputs to comply with above specifications.

Functional Description and Block Diagrams

These converters are primary controlled single transistor forward converters using Pulse With Modulation (PWM). The output voltage is fed back to the primary control circuit via a signal transformer. The second output voltage regulation relies on the close magnetic coupling of the output inductor together with the circuit symmetry. Therefore output 2 should have the same (%) load condition as output 1 to comply with the specified data. The current limitation is located on the primary side, limiting the total output current.

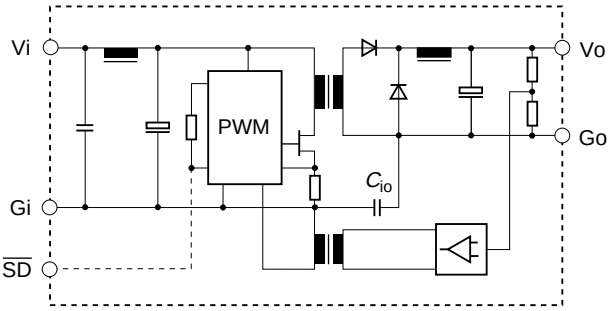


Fig. 2
Group 01, single output

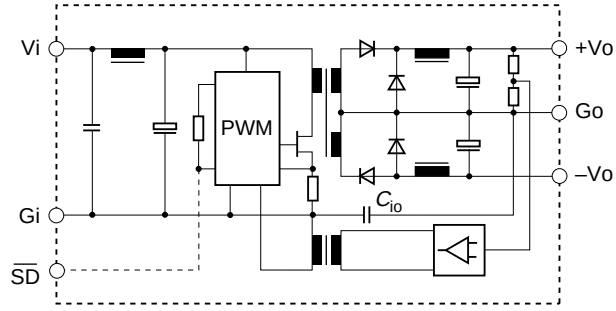


Fig. 3
Group 02, dual output

Mechanical Data

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

European Projection

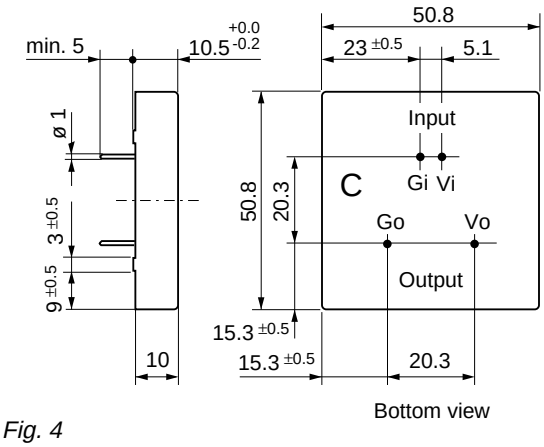


Fig. 4
2"×2" metal case, single output without shutdown
Pin configuration C, available for IPS and IPW-types

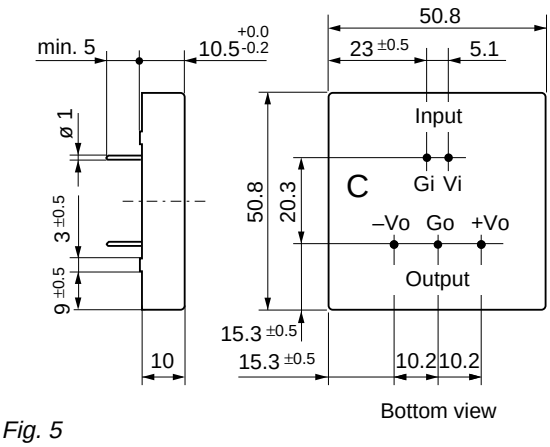


Fig. 5
2"×2" metal case, dual output without shutdown
Pin configuration C, available for IPS and IPW-types

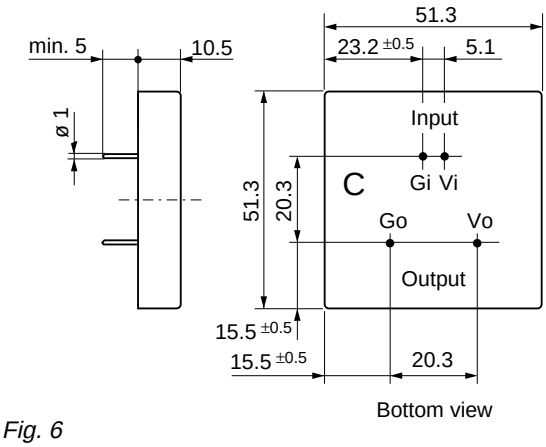


Fig. 6
Plastic case, single output without shutdown
Pin configuration C, available for IPZ-types

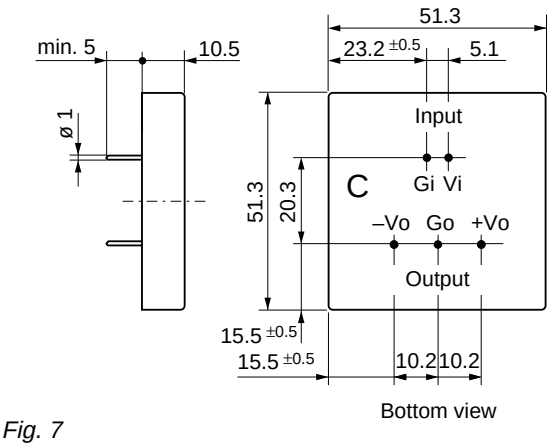


Fig. 7
Plastic case, dual output without shutdown
Pin configuration C, available for IPZ-types

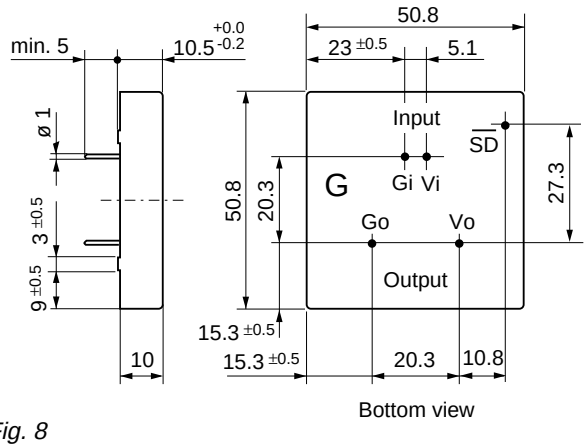


Fig. 8
2"×2" metal case, single output with shutdown
Pin configuration G, available for IPS and IPW-types

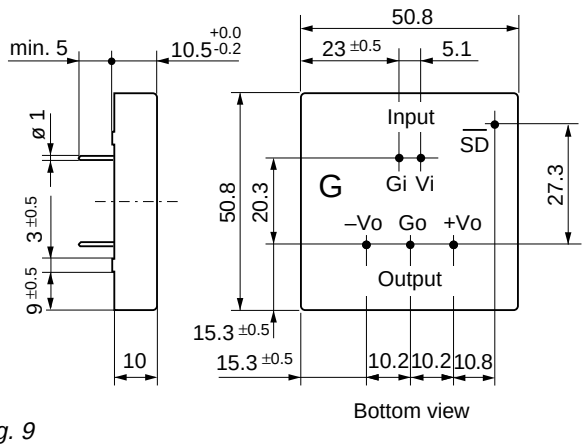


Fig. 9
2"×2" metal case, dual output with shutdown
Pin configuration G, available for IPS and IPW-types

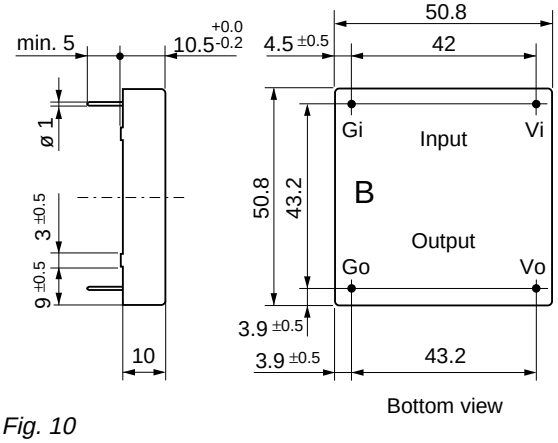


Fig. 10
2"×2" metal case, single output without shutdown
Pin configuration B, available for IPS-types

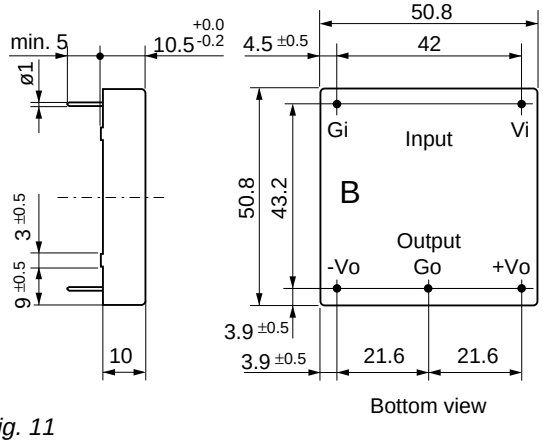


Fig. 11
2"×2" metal case, dual output without shutdown
Pin configuration B, available for IPS-types

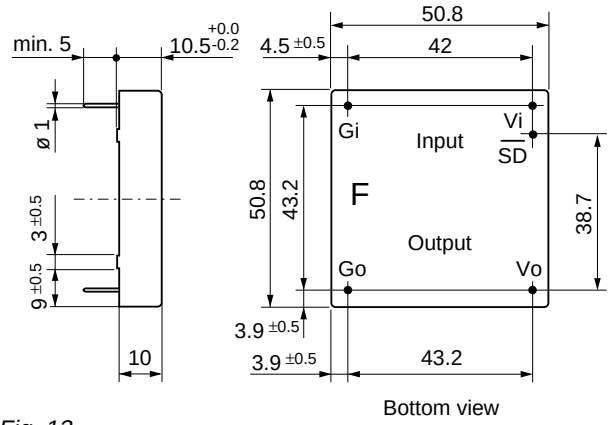


Fig. 12
2"×2" metal case, single output with shutdown
Pin configuration F, available for IPS-types

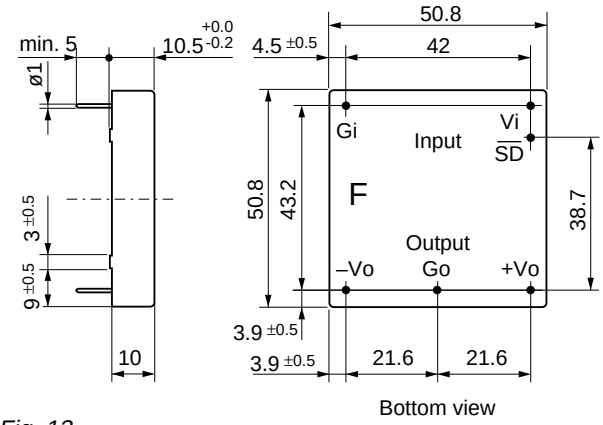
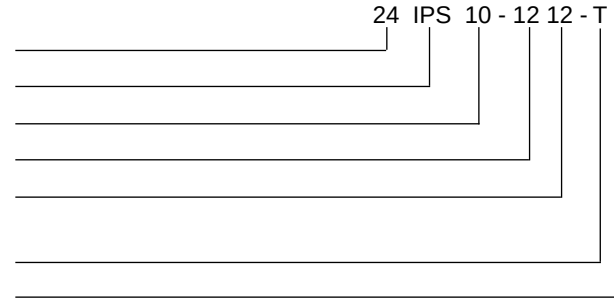


Fig. 13
2"×2" metal case, dual output with shutdown
Pin configuration F, available for IPS-types

Type Key and Product Marking

Type Key:



Nominal input voltage in volt 24, 48
Family ..... IPS, IPW, IPZ
Nominal output power in watts 5, 10
Nominal output voltage for output 1 in volt 05, 12, 15
Nominal output voltage for output 2 in volt 05, 12, 15
Operating ambient temperature range
T_A = –25...71°C ..... T
Pin configuration ..... C, B, G, F

Product Marking:

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