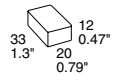


3 Watt DC-DC Converters

IMR 3 Series

Input to output electric strength test 500 V DC Single or dual output

- Input voltage range up to 3:1
- High efficiency up to 73%
- Short-circuit proof
- No derating
- DIL 24 plastic package
- Low cost



Summary

The IMR 3 serie of DC-DC converters have been developed for powering commercial type of electronic circuits, e.g. telephone systems components, industrial controllers and small appliances. They are suitable for applications

with standard battery voltages. The IMR 3 converters feature good efficiency and good dynamic response to load changes and at start-up. The IMR 3 modules are short-circuit and no-load proof.

Type Survey and Key Data

Table 1: Type survey

Output		Output power $P_{o \max}$ [W]	Efficiency ¹ η_{\min} [%]	Input voltage range				Option
$U_{o \text{ nom}}$ [V]	$I_{o \text{ nom}}$ [mA]			$U_{i \text{ min}} \dots U_{i \text{ max}}$ 9...18 V DC ²	$U_{i \text{ min}} \dots U_{i \text{ max}}$ 18...36 V DC	$U_{i \text{ min}} \dots U_{i \text{ max}}$ 20...60 V DC	$U_{i \text{ min}} \dots U_{i \text{ max}}$ 36...72 V DC	
3.3	700	2.3	63	12 IMR 3-03-2	24 IMR 3-03-2	40 IMR 3-03-2	48 IMR 3-03-2	-7
5	500	2.5	63	12 IMR 3-05-2	24 IMR 3-05-2	40 IMR 3-05-2	48 IMR 3-05-2	
12	250	3	65	12 IMR 3-12-2	24 IMR 3-12-2	40 IMR 3-12-2	48 IMR 3-12-2	
15	200	3	65	12 IMR 3-15-2	24 IMR 3-15-2	40 IMR 3-15-2	48 IMR 3-15-2	
±5	250	2.5	65	12 IMR 3-0505-2	24 IMR 3-0505-2	40 IMR 3-0505-2	48 IMR 3-0505-2	
±12	125	3	67	12 IMR 3-1212-2	24 IMR 3-1212-2	40 IMR 3-1212-2	48 IMR 3-1212-2	
±15	100	3	67	12 IMR 3-1515-2	24 IMR 3-1515-2	40 IMR 3-1515-2	48 IMR 3-1515-2	

¹ Efficiency at $U_{i \text{ nom}}$ and $I_{o \text{ nom}}$

² 12 IMR 3 types: Output current $I_{o \text{ nom}}$ see: *Output Data*

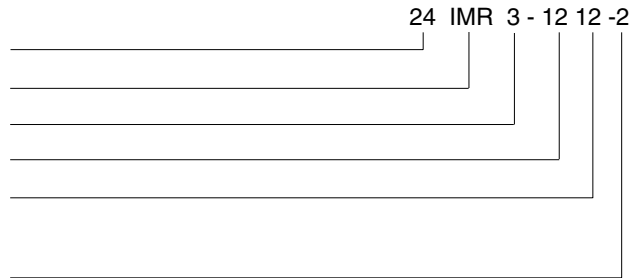
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Type Key

Type Key

Nominal input voltage in volt	12...48
Series	IMR
Nominal output power in watt	3
Nominal output voltage for output 1 in volt	05...15
Nominal output voltage for output 2 in volt	05...15
Operational ambient temperature range T_A	
-10...50°C	-2
-25...71°C (option)	-7



Functional Description

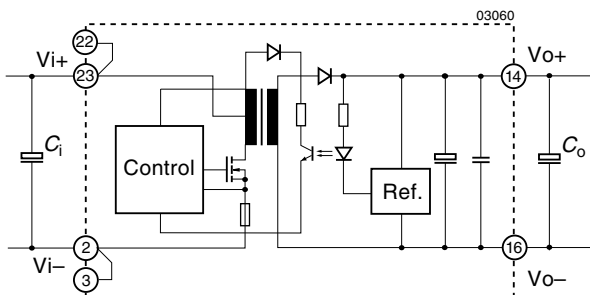


Fig. 1
Single output converter block diagram

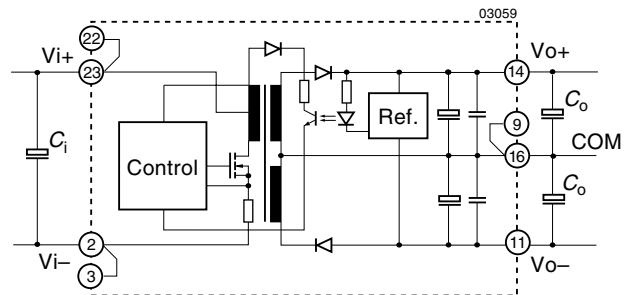


Fig. 2
Dual output converter block diagram

Attention: $C_i = 4.7 \mu\text{F}/100 \text{ V}$ must be added in any application. $C_o = 10 \mu\text{F}$ to minimize ripple and noise to $<100 \text{ mV}_{\text{PP}}$ (Capacitors should be of low ESR types).

Electrical Input Data

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

Table 2a: Input data

Input		Conditions	12 IMR 3			24 IMR 3			Unit
Characteristics			min	typ	max	min	typ	max	
U_i	Input voltage range	$T_A \text{ min...}T_A \text{ max}$ $I_o = 0...I_o \text{ nom}$	9		18	18		36	V DC
$U_{i \text{ nom}}$	Nominal input voltage		12			24			
U_i	Input voltage without damage		0		22	0		40	
i_{i0}	No load input current	$U_{i \text{ nom}}, I_o = 0$	18			12			mA
i_{iL}	Input current limitation response	$U_{i \text{ nom}}, \text{full load}$	$1.25 P_{i \text{ nom}}$			$1.25 P_{i \text{ nom}}$			W
$U_{i \text{ rev}}$	Reverse input voltage protection	$U_i = \text{negative or reverse polarity}$	shunt diode use external fuse			shunt diode use external fuse			

Table 2b: Input data

Input		Conditions	40 IMR 3			48 IMR 3			Unit
Characteristics			min	typ	max	min	typ	max	
U_i	Input voltage range	$T_A \text{ min...} T_A \text{ max}$ $I_o = 0 \dots I_o \text{ nom}$	20		60	36		72	V DC
$U_{i \text{ nom}}$	Nominal input voltage		36			48			
U_i	Input voltage without damage		0		75	0		75	
I_{i0}	No load input current	$U_{i \text{ nom}}, I_o = 0$	8			8			mA
I_{iL}	Input current limitation response	$U_{i \text{ nom}}, \text{ full load}$	$1.25 P_{i \text{ nom}}$			$1.25 P_{i \text{ nom}}$			W
$U_{i \text{ rev}}$	Reverse input voltage protection	$U_i = \text{negative or reverse polarity}$	shunt diode use external fuse			shunt diode use external fuse			

Electrical Output Data

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

Table 3a: Output data for single output types

Output		Conditions	.. IMR 3-03			.. IMR 3-05		.. IMR 3-12		.. IMR 3-15		Unit
Characteristics			min	typ	max	min	typ	max	min	typ	max	
U_o	Output voltage	$U_{i \text{ nom}}, I_o \text{ nom}$	3.24	3.36		4.90	5.10	11.76	12.24	14.70	15.30	V
$I_o \text{ nom}$	Nominal output current: – 12 IMR 3 types – other types	$U_{i \text{ min...} U_{i \text{ max}}}$ $(0.2 \dots 1) I_o \text{ nom}$	560 700		400 500		200 250		150 200		mA	
u_o	Output voltage noise: – without C_o – with C_o	$U_{i \text{ nom}}$ $I_o \text{ nom}$ (BW = 20 MHz)	300 100		300 100		300 100		300 100		mV _{pp}	
ΔU_{oU}	Static line regulation	$U_{i \text{ min...} U_{i \text{ max}}}$ $I_o \text{ nom}$	± 1		± 1		± 1		± 1		%	
ΔU_{oI}	Static load regulation	$U_{i \text{ nom}}$ $(0.2 \dots 1) I_o \text{ nom}$	± 2		± 2		± 2		± 2			
α_{Uo}	Temperature coefficient	$U_{i \text{ nom}}$	± 0.02		± 0.02		± 0.02		± 0.02		%/K	
f_s	Switching frequency	$I_o \text{ nom}$	50		50		50		50		kHz	

Table 3b: Output data for dual output types

Output		Conditions	.. IMR 3-0505			.. IMR 3-1212			.. IMR 3-1515			Unit	
Characteristics			min	typ	max	min	typ	max	min	typ	max		
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
$I_o \text{ nom}$	Nominal output current: – 12 IMR 3 types – other types	$U_{i \text{ min...} U_{i \text{ max}}}$ $(0.2 \dots 1) I_o \text{ nom}$	± 200 ± 250		± 100 ± 125		± 80 ± 100					mA	
u_o	Output voltage noise: – without C_o – with C_o	$U_{i \text{ nom}}$ $I_o \text{ nom}$ (BW = 20 MHz)	300 100		300 100		300 100		300 100		mV _{pp}		
ΔU_{oU}	Static line regulation	$U_{i \text{ min...} U_{i \text{ max}}}$ $I_o \text{ nom}$	± 1		± 1		± 1		± 1		%		
ΔU_{oI}	Static load regulation	$U_{i \text{ nom}}$ $(0.2 \dots 1) I_o \text{ nom}$	± 5		± 5		± 5		± 5				
α_{Uo}	Temperature coefficient	$U_{i \text{ nom}}$	± 0.02		± 0.02		± 0.02		± 0.02		%/K		
f_s	Switching frequency	$I_o \text{ nom}$	50		50		50		50		kHz		

Thermal Considerations

If a converter is operated, the relationship between the ambient temperature T_A and the case temperature T_C depends heavily on the conditions of operation and integration into a system. The thermal conditions are influenced by input voltage, output current, airflow, temperature of surrounding components and surfaces and the properties of the printed circuit board. The specified maximum ambient temperature $T_{A\max}$ is therefore only an indicative value and under practical operating conditions, the ambient temperature T_A may be higher or lower than this value.

Caution: The case temperature T_C measured at the Measuring point of case temperature T_C (see: *Mechanical Data*) may under no circumstances exceed the specified maximum value. The installer must ensure that under all operating conditions T_C remains within the limits stated in the table: *Temperature specifications*.

Connection in Series

The outputs of one or more units can be connected in series. No suppressor diodes are required. Melcher however recommends to protect each individual output with a Zener diode or preferably a suppressor diode, to avoid reverse polarity that may occur if the output voltages do not rise simultaneously.

Electromagnetic Compatibility (EMC)

Filter recommendations for compliance with CISPR 22/EN 55022, class B

Electromagnetic emission requirements according to EN 55022, class B can be easily achieved by adding an external input filter consisting of three additional capacitors and one common mode ring core choke.

The filter components should be placed as close as possible to the input of the converter.

Connection in Parallel

The outputs of several units can be connected in parallel. However, the use of a single unit with a higher power rating is a better choice because of uneven power distribution among the outputs connected in parallel. It is recommended to select converters to be connected in parallel with very small output voltage differences at full load (i.e. $<\pm 0.5\%$). A decoupling diode is not required but recommended.

Protection Scheme

The IMR series is continuously short circuit protected by means of input power limitation. The unit will not be damaged if started up into a short circuit. After removal of the short circuit, it will resume normal operation.

The IMR series is also no-load proof, meaning that the regulation is still effective with no load and the output voltage does not rise. However, due to component tolerances, oscillation could occur and ripple and noise can be outside of specified values. If the converter is used in sensitive electronic circuits with no-load conditions, it is recommended to pre-load the outputs with at least 20% of the specified nominal load.

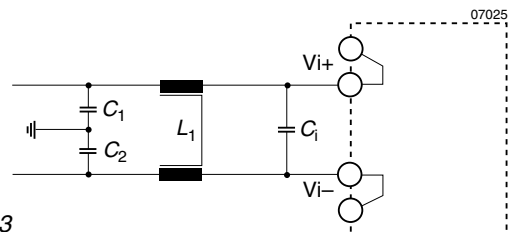


Fig. 3 Input filter arrangement

Table 4: Input filter components

Input voltage	C_1	C_2	Type	L_1	Type	C_i	Type
12, 24, 40, 48 V DC	2.2 μF^1 100 V	2.2 μF^1 100 V	Siemens B 32522 C1225-K	2.2 mH	Siemens B 82722 A2202-N1	4.7 μF 100 V	Al-Chip (low ESR)

¹ Only valid for input voltages up to 60 V DC.

Immunity to Environmental Conditions

Table 5: Temperature specifications, valid for air pressure of 800...1200 hPa (800...1200 mbar)

Temperature			Standard -2		Option -7		Unit
Characteristics	Conditions	min	max	min	max		
T_A	Ambient temperature	$U_{i\text{nom}}$ $I_o = I_{o\text{nom}}$	-10	50	-25	71	°C
T_C	Case temperature		-10	80	-25	85	
T_S	Storage temperature	Non operational	-25	85	-40	100	

Table 6: MTBF

Values at specified case temperature	Ground Benign 40°C	Ground Fixed 40°C	Ground Mobile 50°C
MTBF according to MIL-HDBK-217F, N2	3'984'000 h	896'100 h	343'800 h

Mechanical Data

Dimensions in mm. Tolerances ± 0.3 mm unless otherwise specified.

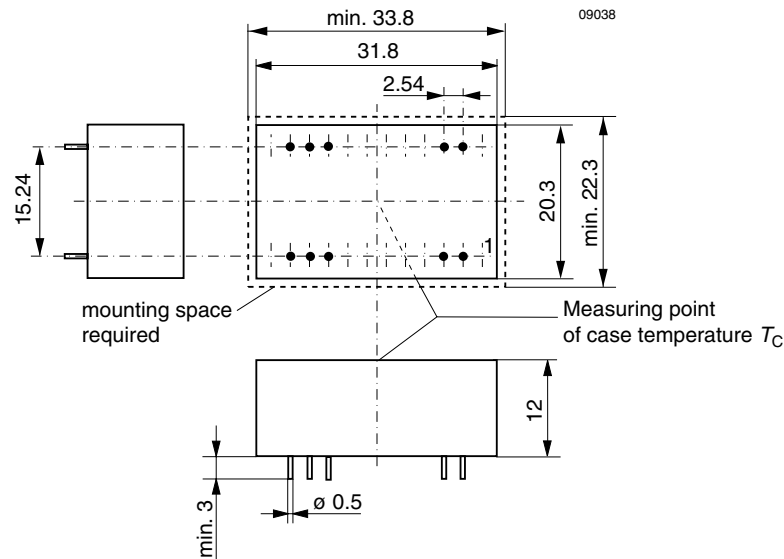
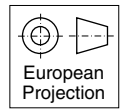


Fig. 4
Case: DIL 24
Weight: 16 g

Safety and Installation Instructions

Installation Instruction

Installation of the DC-DC converters must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings and segregation requirements of the end-use application.

Connection to the system shall be made via a printed circuit board according to: *Mechanical Data*.

The units should be connected to a secondary circuit.

Check for hazardous voltages before altering any connections.

Ensure that a unit failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also: *Safety of operator accessible output circuit*.

Input Fuse

To prevent excessive current flowing through the input supply line in case of a short-circuit across the converter input an external fuse should be installed in a non earthed input supply line. We recommend a fast acting fuse F2A for 12 IMR 3 types, F1A for 24 IMR 3 types, F0.5A for 40 IMR 3 and 48 IMR 3 types.

Cleaning Agents

In order to avoid possible damage, any penetration of cleaning fluids is to be prevented, since the power supplies are not hermetically sealed.

Protection Degree

The protection degree of the DC-DC converters is IP 40.

Table 7: Pin allocation

Pin	Single output unit	Dual output unit
2	Vi-	Vi-
3	Vi-	Vi-
9	n.c.	COM
10	n.c.	n.c.
11	n.c.	Vo-
14	Vo+	Vo+
15	n.c.	n.c.
16	Vo-	COM
22	Vi+	Vi+
23	Vi+	Vi+

Table 8: Electric strength test voltages, clearance and creepage distances

Characteristic	Input to output	Unit
Electric strength test voltage 1 s	350	V_{rms}
	500	V DC
Coupling capacitance	≈ 45	pF
Isulation resistance at 500 V DC	>1000	M Ω

Safety of operator accessible output circuit

If the output circuit of a DC-DC converter is operator accessible, it shall be an SELV circuit according to IEC/EN 60950 related safety standards

The following table shows some possible installation configurations, compliance with which causes the output circuit of the DC-DC converter to be an SELV circuit according to IEC/EN 60950 up to a configured output voltage (sum of nominal voltages if in series or +/- configuration) of 30 V.

However, it is the sole responsibility of the installer to assure the compliance with the relevant and applicable safety regulations. More information is given in: *Technical Information: Safety*.

Standards and approvals

The units have been evaluated for:

- Building in
- Operational insulation input to output
- The use in a pollution degree 2 environment
- Connecting the input to a secondary circuit which is subject to a maximum transient rating of 500 V.

Isolation

The electric strength test is performed as factory test in accordance with IEC/EN 60950 and UL 1950 and should not be repeated in the field. Melcher will not honour any guarantee claims resulting from electric strength field tests.

Table 9: Insulation concept leading to an SELV output circuit

Conditions	Front end			DC-DC converter	Result
Supply voltage	Minimum required grade of isolation, to be provided by the AC-DC front end, including mains supplied battery charger	Maximum DC output voltage from the front end ¹	Minimum required safety status of the front end output circuit	Measures to achieve the specified safety status of the output circuit	Safety status of the DC-DC converter output circuit
Mains ≤250 V AC	Basic	≤60 V	Earthed SELV circuit ²	Operational insulation, provided by the DC-DC converter	SELV circuit
			ELV circuit	Input fuse ³ output suppressor diodes ⁴ , and earthed output circuit ²	Earthed SELV circuit
		>60 V	Hazardous voltage secondary circuit		
	Double or reinforced	≤60 V	SELV circuit	Operational insulation, provided by the DC-DC converter	SELV circuit
			TNV-2 circuit	Earthed output circuit ²	Earthed SELV
		>60 V	Double or reinforced insulated unearthed hazardous voltage secondary circuit ⁵	Input fuse ³ and output suppressor diodes ⁴	SELV circuit

¹ The front end output voltage should match the specified input voltage range of the DC-DC converter.

² The earth connection has to be provided by the installer according to the relevant safety standard, e.g. IEC/EN 60950.

³ The installer shall provide an approved fuse (type with the lowest rating suitable for the application) in a non-earthed input conductor directly at the input of the DC-DC converter (see fig.: *Schematic safety concept*). For UL's purpose, the fuse needs to be UL-listed. See also *Input Fuse*.

⁴ Each suppressor diode should be dimensioned in such a way, that in the case of an insulation fault the diode is able to limit the output voltage to SELV (<60 V) until the input fuse blows (see fig.: *Schematic safety concept*).

⁵ Has to be insulated from earth by double or reinforced insulation according to the relevant safety standard, based on the maximum output voltage from the front end.

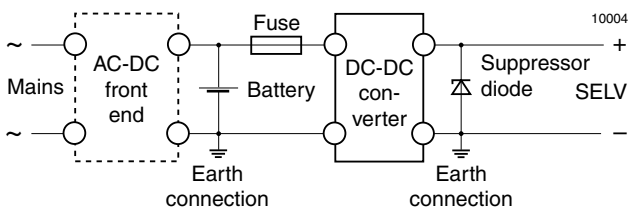


Fig. 5
Schematic safety concept. Use fuse, suppressor diode and earth connection as per table: Safety concept leading to an SELV output circuit.