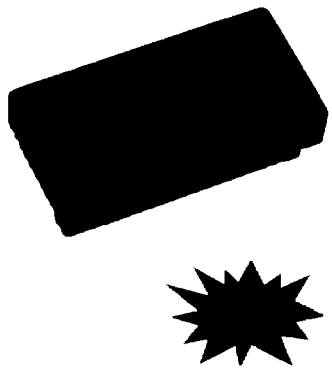
# 7 W DC-DC Converters

# IMX 7-Family

**Input/output isolation test voltage up to 1500 $V_{rms}$**
**Single, double outputs of 3.3, 5, 12, 15 and 24 V DC**
**Input voltage ranges: 8.4...36 V DC, 16.8...75 V DC and 40...121 V DC**



- Extremely wide input voltage ranges
- Galvanic isolation, single and double output units
- High efficiency (typ. >84%)
- Inhibit input, output voltage adjustable
- No load and short-circuit proof
- High reliability and no derating
- Operating ambient temperature ranges from –25...+71°C up to –40...+85°C
- Emissions below EN 55 022 level B.
- Immunity to IEC 1000- 4 -2, -3, -4, -5 and -6
- 2" x 1" case with 10.5 mm profile

Safety according to IEC 950

CE[1]

[1] For 70 IMX types

6.1

## Table of Contents



## Type Survey

*Table 1: Type survey*

| Output 1 | | Output 2 | | Input Voltage Range and Efficiency | | | | | | Option |
|---|---|---|---|---|---|---|---|---|---|---|
| $U_{o\,nom}$ V DC | $I_{o\,nom}$ [1] A | $U_{o\,nom}$ V DC | $I_{o\,nom}$ [1] A | $U_{i\,min}...U_{i\,max}$ **8.4...36 V DC** | $\eta_{typ}$ % | $U_{i\,min}...U_{i\,max}$ **16.8...75 V DC** | $\eta_{typ}$ % | $U_{i\,min}...U_{i\,max}$ **40...121 V DC** | $\eta_{typ}$ % | [2] |
| 3.3 | 1.5 | | | 20 IMX 7-03-7 | 77 | 40 IMX 7-03-7 | 78 | 70 IMX 7-03-7 | 77 | -8 |
| 5.1 | 1.2 | | | 20 IMX 7-05-7 | 80 | 40 IMX 7-05-7 | 81 | 70 IMX 7-05-7 | 81 | -9 |
| 5 | 0.6/0.7 | 5 | 0.6/0.7 | 20 IMX 7-05-05-7 | 82 | 40 IMX 7-05-05-7 | 83 | 70 IMX 7-05-05-7 | 82 | D |
| 12 | 0.25/0.3 | 12 | 0.25/0.3 | 20 IMX 7-12-12-7 | 84 | 40 IMX 7-12-12-7 | 84 | 70 IMX 7-12-12-7 | 83 | X |
| 15 | 0.2/0.24 | 15 | 0.2/0.24 | 20 IMX 7-15-15-7 | 84 | 40 IMX 7-15-15-7 | 84 | 70 IMX 7-15-15-7 | 83 | M |
| 24 | 0.13/0.15 | 24 | 0.13/0.15 | 20 IMX 7-24-24-7 | 84 | 40 IMX 7-24-24-7 | 84 | 70 IMX 7-24-24-7 | 83 | C |

[1] 20 IMX 7 types have reduced output power (approximately 6 W) [2] See table 8: "Survey of options"

## Description

The IMX 7 series has been designed according to the latest industry requirements and standards (1995) and is particularly suitable for industrial and telecom applications. The converters are ideal for use in applications where variable input voltages or high input transients are prevalent, e.g. mobile applications. They feature consistently high efficiency over the entire input voltage range, high reliability and good dynamic response to line and load changes.

A special feature is their small case size, 2"×1" with 10.5 mm height. Generous design margins have been applied. The circuit is mounted on a single PCB, all components solidly soldered without any wire connections and no potting material is applied. The thermal design allows operation at nominal load up to an ambient temperature of 85°C in free air. For extremely high vibration environments the case has holes allowing screw mounting.

## Functional Description

The IMX 7 DC-DC modules are feedback controlled flyback converters using current mode PWM (Pulse Width Modulation). See fig. 1 and 2.

In the case of the single output units the output is directly monitored and fed back to the primary control circuit via a pulse transformer, resulting in tight regulation of the output voltage. The R-input is referenced to the secondary side and allows for programming of the output voltages in the range 75 to 105% of $U_{o\,nom}$ using either an external resistor or an external voltage source.

In the case of the double output units the output voltage is monitored by a separate transformer winding close to the secondary windings and fed back to the control circuit. The R-input is referenced to the primary side and allows programming of the output voltage in the range 100 to 105% of $U_{o\,nom}$ by an external resistor or within 75 to 105% of $U_{o\,nom}$ using an external voltage source.

Current limitation is provided by the primary circuit, thus limiting the total output current ($I_{o\,nom}$ for the single and $I_{o1\,nom} + I_{o2\,nom}$ for the double output types).

The inhibit input allows remote converter shut down.

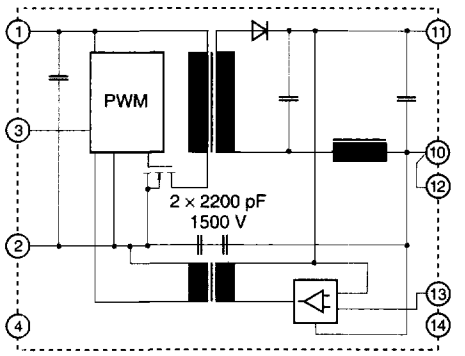



*Fig. 1*
*Block diagram, single output types, standard pinout*

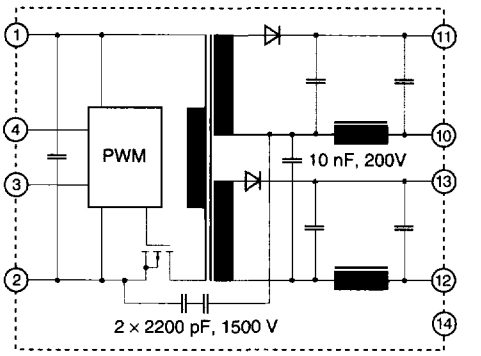



*Fig. 2*
*Block diagram, double output types, standard pinout*

*Table 2: Pin allocation, standard pinout see fig. 16 and 17*

| Pin | Single output units | Double output units |
|---|---|---|
| 1 | Vi+ | Vi+ |
| 2 | Vi– | Vi– |
| 3 | i | i |
| 4 | n.c. | R |
| 10 | Vo– | Vo1– |
| 11 | Vo+ | Vo1+ |
| 12 | Vo– | Vo2– |
| 13 | R | Vo2+ |
| 14 | n.c./D [1] | n.c. |

[1] Option D

*Table 3: Pin allocation for C-pinout (option C) see fig. 3 and 18*

| Pin | Single output units | Dual output units |
|---|---|---|
| 1 | Vi+ | Vi+ |
| 2 | Vi– | Vi– |
| 3 | Vo+ | Vo1+ |
| 4 | n.c. | Go |
| 5 | Vo– | Vo2– |

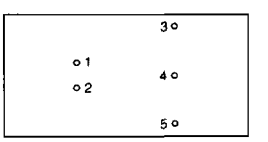



*Fig. 3*
*C-pinout*

## Safety and Installation Instructions

The converters comply with IEC 950, EN 60950 and UL 1950 and are designed to meet EN 41003. The unit should be connected to a secondary circuit.

### Isolation

Input to output electric strength tests in accordance with the safety standards IEC 950, EN 60950, VDE 0805 and EN 41003 respectively are performed as factory tests and should not be repeated in the field.

### Important Advice

**Melcher will not honour any guarantee/warranty claims resulting from high voltage tests.**

### Cleaning Processes

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

*Table 4: Elecric strength test voltages and creepage distances*

| Characteristics | Input/Output 20/40 IMX | Input/Output 70 IMX | Output/Output | Unit |
|---|---|---|---|---|
| Electric strength test voltage | 1.2 | 1.5 | 0.1 | $kV_{rms}$ |
| | 1.5 | | 0.15 | kV DC |
| Creepage distances | 1.6 | 2.0 | 0.4 | mm |

### Safety

If the output circuit of an IMX-family 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 60 V DC).

In the following table 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 table 5 is observed, the output of any IMX-family 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 5: 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 |
|---|---|---|---|---|---|
| ≤150 V | Basic | ≤60 V | Earthed SELV circuit [1] | Operational | SELV circuit |
| | | ≤121 V | Unearthed hazardous voltage secondary circuit [2] | Supplementary, based on AC 150 V | |
| ≤250 V | Basic | ≤60 V | Earthed SELV circuit [1] | Operational | |
| | Double or reinforced | ≤60 V | SELV circuit | Operational | |
| | | ≤121 V | Double or reinforced insulated unearthed hazardous voltage secondary circuit, supplying an SELV circuit [2] | Supplementary. based on DC 121 V | |

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

[2] 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.

## Electrical Input and Output Data

General conditions: $T_A$ = 25°C, unless $T_C$ is specified.

*Table 6: Input Data*

| Input Characteristics | | Conditions | 20 IMX 7 min | 20 IMX 7 typ | 20 IMX 7 max | 40 IMX 7 min | 40 IMX 7 typ | 40 IMX 7 max | 70 IMX 7 min | 70 IMX 7 typ | 70 IMX 7 max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $U_i$ | Input voltage range [1] | $T_{A\,min}$... $T_{A\,max}$ | 8.4 | | 36 | 16.8 | | 75 | 40 | | 121 | V DC |
| $U_{i\,nom}$ | Input voltage (nominal) | $I_o$ = 0... $I_{o\,nom}$ | | 20 | | | 40 | | | 70 | | |
| $U_{i\,sur}$ | Repetitive surge voltage | max. 3 s | | | | | | 100 | | | | |
| | | max. 10 ms | | | 45 | | | [5] | | | [5] | |
| $t_{start\,up}$ | Converter [2] start-up time | Worst case condition at $U_{i\,min}$ and full load | | 0.25 | 0.5 | | 0.25 | 0.5 | | 0.25 | 0.5 | s |
| $t_{ris}$ | Rise time [2] | $U_{i\,nom}$, $I_{o\,nom}$ resistive load | | 5 | | | 5 | | | 5 | | ms |
| | | capacitive load | | 12 | | | 12 | | | 12 | | |
| $I_{io}$ | No load input current | $I_o$ = 0, $U_{i\,min}$... $U_{i\,max}$ | | 15 | 30 | | 8 | 15 | | 8 | 15 | mA |
| $I_{i\,rr}$ | Reflected ripple current | $I_o$ = 0... $I_{o\,nom}$ | | | 30 | | | 30 | | | 30 | $mA_{pp}$ |
| $U_{i\,RFI}$ | Input RFI level conducted and radiated | EN 55022 [4] | | B | | | B | | | B | | |
| $C_i$ | Input capacitance | for surge calculations | | 1.2 | | | 0.5 | | | 0.5 | | µF |
| $U_{ih}$ | Inhibit voltage [3] | Converter operating | | −10...0.8 | | | −10 ...0.8 | | | −10 ...0.8 | | V DC |
| | | Converter inhibited | | open, 2.4... $U_{i\,max}$ | | | open, 2.4... $U_{i\,max}$ | | | open, 2.4... $U_{i\,max}$ | | |
| $I_{ih}$ | Inhibit current | Converter operating | | −0.5 | | | −0.5 | | | −0.5 | | mA |
| | | Converter inhibited | | 1 | | | 1 | | | 1 | | |
| $I_{i\,ih}$ | Input current if unit inhibited | $U_{i\,min}$... $U_{i\,max}$ | | <3.0 | | | <3.0 | | | <3.0 | | |
| $f_s$ | Switching frequency | $U_{i\,min}$... $U_{i\,max}$, $I_o$ = 0... $I_{o\,min}$ | | approx. 400 | | | approx. 400 | | | approx. 400 | | kHz |

[1] $U_{i\,min}$ will not be as stated if $U_o$ is increased above $U_{o\,nom}$ by use of the R input pin. If the output voltage is set to a higher value, $U_{i\,min}$ will be proportionally increased.
[2] Measured with a resistive or max. admissable capacitive load. (See fig. 4)
[3] Switching times are typically 10 ms for transition from one state to another.
[4] Measured with a lead lenght of 0.1 m, leads twisted. Double output units with both outputs in parallel.
[5] See 19 Pfl 1, table 10

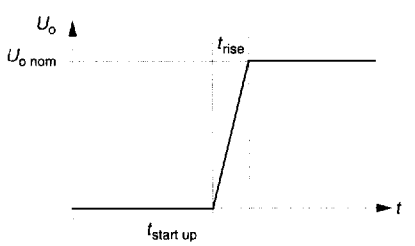



*Fig. 4*
*Converter start-up and rise time*

*Table 7a: Output data for single output units*

| Output | | $U_{o\,nom}$ | 3.3 V | | | 5.1 V | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Characteristics | | Conditions | min | typ | max | min | typ | max | |
| $U_o$ | Output voltage | $U_{i\,nom}$<br>$I_o = 0.5\ I_{o\,nom}$ | 3.28 | | 3.32 | 5.07 | | 5.13 | V DC |
| $I_{o\,nom}$ | Output current | $U_{i\,min}...U_{i\,max}$ | | 1.5 | | | 1.2 | | A |
| $I_{CL}$ | Current limit [1] | $U_{i\,nom}$, $T_C = 25°C$ | | | 3.0 | | | 2.4 | |
| $\Delta U_{o\,U}$ | Line and load regulation | $U_{i\,min}...U_{i\,max}$<br>$I_o = (0.01...1)\ I_{o\,nom}$ | | | ±1 | | | ±1 | % |
| $u_{o1/2}$ | Output voltage ripple and noise | $U_{i\,min}...U_{i\,max}$<br>$I_o = I_{o\,nom}$<br>(BW = 20 MHz) | | | 70 | | | 70 | $mV_{pp}$ |
| $U_{o\,clp}$ | Output overvoltage clamping | | 115 | | 130 | 115 | | 130 | % |
| $\alpha_{Uo}$ | Temperature coeff. | $\Delta U_o/\Delta$ TC | | ±0.02 | | | ±0.02 | | %/K |
| $C_{o\,ext}$ | Admissable capacitive load | | | | ≤2500 | | | ≤2000 | µF |
| $t_d$ | Dynamic load transient response time | $U_{i\,nom}$<br>$I_o = (1...1/4...1)\ I_{o\,nom}$ | | 1 | | | 1 | | ms |
| $\Delta U_{o\,td}$ | Transient output voltage deviation | | | ±150 | | | ±150 | | mV |

*Table 7b: Output data for double outputs units*

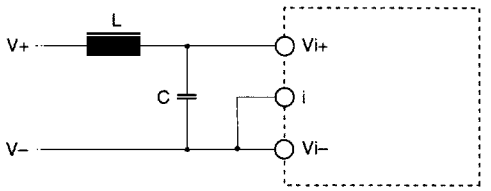
| Output | | $U_{o\,nom}$ | 2 × 5 V | | | 2 × 12 V | | | 2 × 15 V | | | 2 × 24 V | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Characteristics | | Conditions | min | typ | max | min | typ | max | min | typ | max | min | typ | max | |
| $U_{o1}$<br>$U_{o2}$ | Output voltage | $U_{i\,nom}$<br>$I_o = 0.5\ I_{o\,nom}$ | 4.97<br>4.95 | | 5.03<br>5.05 | 11.93<br>11.88 | | 12.07<br>12.12 | 14.90<br>14.85 | | 15.10<br>15.15 | 23.85<br>23.75 | | 24.15<br>24.25 | VDC |
| $I_{o\,nom}$ | Output current [1] 20 IMX | $U_{i\,min}...U_{i\,max}$ | 2 × 0.60 | | | 2 × 0.25 | | | 2 × 0.20 | | | 2 × 0.12 | | | A |
| | 40/70 IMX | | 2 × 0.70 | | | 2 × 0.30 | | | 2 × 0.24 | | | 2 × 0.15 | | | |
| $I_{CL}$ | Current limit [1,2] 20 IMX | $U_{i\,nom}$, $T_C = 25°C$ | | | 2.4 | | | 1.0 | | | 0.95 | | | 0.5 | |
| | 40/70 IMX | | | | 2.8 | | | 1.2 | | | 1.1 | | | 0.6 | |
| $\Delta U_{o\,U}$ | Line regulation | $U_{i\,min}...U_{i\,max}$<br>$I_{o\,nom}$ | | | ±1 | | | ±1 | | | ±1 | | | ±1 | % |
| $\Delta U_{o\,I}$ | Load regulation [3] | $U_{i\,nom}$<br>$I_o = (0,1...1)\ I_{o\,nom}$ | | | ±3 | | | ±3 | | | ±3 | | | ±3 | |
| $u_{o1/2}$ | Output voltage ripple and noise | $U_{i\,min}...U_{i\,max}$<br>$I_o = I_{o\,nom}$<br>(BW = 20 MHz) | | | 80 | | | 120 | | | 150 | | | 240 | $mV_{pp}$ |
| $U_{o\,clp}$ | Output overvoltage clamping [4] | Applies to both $V_{o1}$ and $V_{o2}$ | 115 | | 130 | 115 | | 130 | 115 | | 130 | 115 | | 130 | % |
| $\alpha_{Uo}$ | Temperature coeff. | $\Delta U_o/\Delta$ TC | | ±0.02 | | | ±0.02 | | | ±0.02 | | | ±0.02 | | %/K |
| $C_{o\,ext}$ | Admissable capacitive load [2] | | | | ≤2000 | | | ≤300 | | | ≤200 | | | ≤100 | µF |
| $t_d$ | Dynamic load transient response time [2] | $U_{i\,nom}$<br>$I_o = (1...1/4...1)\ I_{o\,nom}$ | | 1 | | | 1 | | | 1 | | | 1 | | ms |
| $\Delta U_{o\,td}$ | Transient output voltage deviation | | | ±150 | | | ±330 | | | ±350 | | | ±600 | | mV |

[1] The current limit is primary side controlled.
[2] Measured with both outputs connected in parallel.
[3] Conditions for specified output. Other output loaded with constant current $I_o = 0.5\ I_{o\,nom}$.
[4] The overvoltage protection device is a zener diode whose breakdown region is typically 120...125% of the nominal output voltage. The zener diode protects the converter only against internally generated overvoltages.

### Input Transient Voltage Protection

A suppressor diode on the input together with the input filter provides an effective protection against input transients.

To achieve IEC 801-5, level 2 compliance for 40/70 IMX 7 types or to withstand the 150 V transient according to 19 Pfl 1 an additional inductor and capacitor should be provided externally, as shown below. (Not applicable for 20 IMX 7 types.)




**Inductor (L):**
Manufacturer: TOKO
Part Number: 494LYF-0098K
Characteristics: 330 µH, 0.65 Ω, 620 mA

**Capacitor (C):**
Manufacturer: Nippon Chemi-Con
Part Number: SXE 100 VB 68 M 125
Characteristics: 68 µF, 100 V, 105°C, 190 mΩ

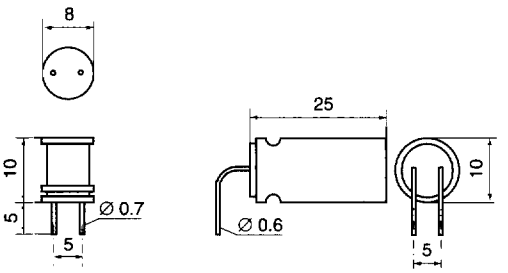



*Fig. 5*
*Example for external circuitry to comply with IEC 801-5, level 2, for 40 IMX 7 types*

### Reverse Polarity Protection at Input

The suppressor diode on the input also provides for reverse polarity protection by conducting current in the reverse direction, thus protecting the unit. An external fuse is required to limit this current:
– For 20 IMX 7 a fast 2 A (F2A) fuse is recommended.
– For 40 IMX 7 a fast 1 A (F1A) fuse is recommended.
– For 70 IMX 7 a fast 0.63 A (F.63A) fuse is recommended.

### Inrush Current

The inrush current has been kept as low as possible by choosing a very small input capacitance. A series resistor may be inserted in the input line to limit this current further.

### Output Overvoltage Protection

The outputs of the units (single and double) are protected against overvoltages by a zener diode across one of the outputs. The main purpose of this feature is to protect against possible overvoltages which could occur due to a failure in the feedback control circuit. Under worst case conditions the suppressor diode will short circuit. The suppressor diode is not designed to withstand externally applied overvoltages. In the case of the double outputs since both outputs track each other a suppressor diode is only provided on one of the outputs.

6.1

## Description of Options

*Table 8: Survey of options*

| Option | Function | Characteristics |
|---|---|---|
| -8 | Operational temperature range $T_A$ = –40...85 °C | Extended temperature range. Excludes option D. |
| -9 | Operational temperature range $T_A$ = –40...71 °C | Extended temperature range. |
| D | Signal Out OK | Available for single output units. Excludes option -8. |
| X | LED $U_o$ present | Available for double output units. |
| M | Surface mount version, SMD | Excludes option C. |
| C | C-pinout | Excludes option M as well as galvanic isolation between output 1 and 2 of double output units. |

### Option -8

Extension of the temperature range from standard –25...71 °C to –40...85 °C. The modules will provide full output power with free air convection cooling. UL recognition up to 80°C. This option excludes option D.

### Option -9

Extension of the temperature range from standard –25...71 °C to –40...71 °C. The modules will provide full output power with free air convection cooling.

### Option D

Single output units can be provided with a signal Out OK. The Out OK signal is an open collector transistor output referenced to Vo– and indicates that the output voltage is above approximately 90% of the specified nominal output voltage. It can for example be used for remote signalling or to prevent a connected system from starting up at a low output voltage. The current $I_D$ through the NPN transistor should not exceed 20 mA. The NPN output is not protected against external overvoltages. $U_D$ should not exceed 25 V. Option D excludes option -8.

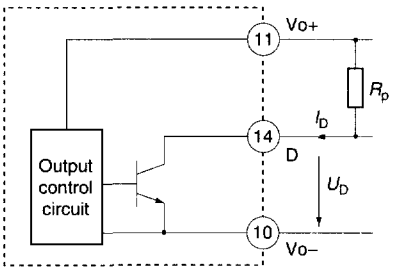



*Fig. 6*
*Option D, Out OK*

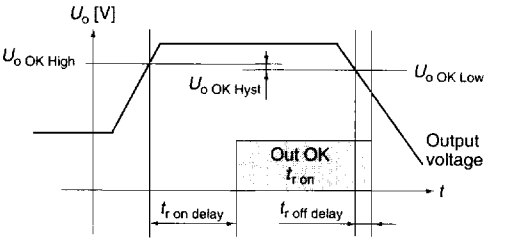



*Fig. 7*
*Out OK signal with corresponding transistor status*

*Table 9: Out OK characteristics*

| Out OK characteristics | | 3.3 V units $U_o$ | | 5.1 V units $U_o$ | | Unit |
|---|---|---|---|---|---|---|
| | | min | max | min | max | |
| $D_{on}$ | D output conducting | | 3.0 | | 4.75 | V |
| $D_{off}$ | D output disabled | 2.85 | | 4.5 | | |
| $U_{o\ OK\ Hyst}$ | Hysteresis | 30 (typical) | | | | mV |
| $t_{r\ on\ delay}$ | Transistor on delay | 140 | 560 | 140 | 560 | ms |
| $t_{r\ off\ delay}$ | Transistor off delay | | 100 | | 100 | µs |

### Option X

A yellow LED is provided indicating that the output voltage is present.
Option X is available for double output units.

### Option M

Surface mount version. See fig. 17.
Option M excludes option C.

**Note:** Precautions should be taken when reflow soldering the SMD version, option M. Please request the soldering instructions for information about reflow soldering. These instructions should be strictly adhered to. An inadequate soldering process may permanently damage the converter or degrade its performance and Melcher will not honour any guarantee/ warranty claims resulting from damage caused by ignoring the soldering instructions.

**Infrared soldering is not permitted.**

### Option C

The C-pinout allows for integration into designs where e.g. a second source is a must. With the C-pinout the converter height is increased by the adapter PCB (see also fig. 18).

Option C excludes option M, the inhibit function as well as the R-function. Double outputs are connected in series.

## Electromagnetic Compatibility EMC

A suppressor diode together with an input filter form an effective protection against high input transient voltages which typically occur in many installations, but especially in battery driven mobile applications.

### Electromagnetic Immunity, Generic Standard prEN 50082-2

*Table 10: Immunity type tests*

| Phenomenon | Standard | Level | Coupling mode [3] | Value applied | Waveform | Source impedance | Test procedure | In operation | Performance |
|---|---|---|---|---|---|---|---|---|---|
| Electrostatic discharge | IEC 801-2 (1991-04) IEC 1000-4-2 | 2 | contact discharge to case R-pin open i-pin connec. to Vi– | 4000 $V_p$ | 1/50 ns | 330 Ω | 10 positive and 10 negative discharges | yes | 2 |
| | | 3 | air dischg. to case R-pin open i-pin connec. to Vi– | 8000 $V_p$ | | | | | |
| Electric field | IEC 801-3 (1984) IEC 1000-4-3 | 3 | antenna in 1 m distance | 10 V/m | AM modulated 80% 1 kHz | | 26...1000 MHz | yes | 2 |
| Fast transient/ burst | IEC 801-4 (1988) IEC 1000-4-4 | 4 | +i/–i | 4000 $V_p$ | bursts of 5/50 ns 5 kHz rep. rate transients with 15 ms burst duration and a 300 ms period | 50 Ω | 1 min positive 1 min negative bursts per coupling mode | yes | 2 |
| Transient | IEC 801-5 [4] (Draft 1993-01) IEC 1000-4-5 [4] | 2 | +i/–i | 1000 $V_p$ | 1.2/50 µs | 2 Ω | 5 positive and 5 negative impulses per coupling mode | yes | 2 |
| Conducted disturbance | IEC 801-6 IEC 1000-4-6 | 3 | +i/–i | 140 dBµV (10 $V_{rms}$) | AM modulated 80%, 1 kHz | 50 Ω | 0.15...80 MHz 150 Ω | yes | 5 |
| Transient | 19 Pfl 1 [4] | | +i/–i | 150 $V_p$ | 0.1/0.3 ms | limited to <100 A | 3 positive 5 repetitions | yes | 2 |

[1] Normal operation
[2] Normal operation, temporary deviations from specific. possible
[3] i = input, o = output
[4] 40/70 IMX 7 (Additional external components required). Not applicable for 20 IMX 7 types
[5] Test in progress

### Electromagnetic Emission

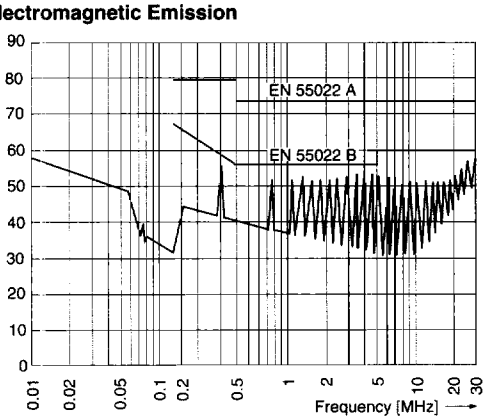



*Fig. 8*
*Typical radio frequency interference voltage at $U_{o\,nom}$, $I_{o\,nom}$, measured with an artifical mains network and a quasi peak detector. Output leads 0.1 m, twisted. (40 IMX 7-15-15-7R)*

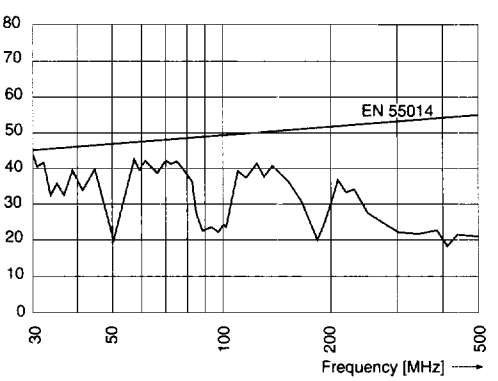



*Fig. 9*
*Typical radiated noise measured with a MDS clamp at $P_{o\,nom}$. Output leads 0.1 m, twisted. (40 IMX 7-15-15-7R)*

## Supplementary Data

### Inhibit Function

The output(s) of the converter may be enabled or disabled by means of a logic signal (TTL, CMOS, etc.) applied to the inhibit pin. No output voltage overshoot will occur when the unit is turned on. If the inhibit function is not required the inhibit pin should be connected to Vo– to enable the output (active low logic, fail safe).

Converter operating: –10 V...0.8 V
Converter inhibited
or inhibit pin left open: 2.4 V...$U_{i\,max}$ (<75 V for 70 IMX 7)

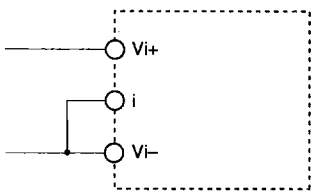



*Fig. 10*
*If the inhibit is not used the inhibit pin should be connected to Vi–*

### Connection in Series or in Parallel

Connection in series:
The outputs of single or double output units can be connected in series without any precautions, taking into consideration that the highest output voltage should remain below 60 V for SELV operation.

Connection in parallel:
The outputs of one or several double output units with equal nominal voltage can be connected in parallel. Approximate current sharing between 2 or several units is ensured by their load dependent output characteristic.

### Short Circuit Behaviour

The current limit characteristic shuts down the converter whenever a short circuit is applied to its output. It acts self-protecting and automatically recovers after removal of the overload condition.

### Adjustable Output Voltage (R-input)

As a standard feature, the IMX 7 single and double output units offer adjustable output voltage(s) by using the control input R pin. If the R pin is left open circuit the output voltage is set to $U_{o\,nom}$. The output voltage is adjustable in the range 75...105% of $U_{o\,nom}$. The circuit works for single and double output units in a different way. For output voltages $U_o > U_{o\,nom}$, the minimum input voltage $U_{i\,min}$ (see "Electrical Input Data") increases proportionally to $U_o/U_{o\,nom}$.

*Single output units:*

The R input control pin is referenced to the secondary side of the converter. Adjustment of the output voltage is possible by means of either an external resistor or a voltage source.

a) Adjustment by means of an external resistor $R_{ext}$:

Depending upon the value of the required output voltage, the resistor shall be connected

**either:** Between the R pin and Vo– to achieve an output voltage adjustment range of approximately $U_o$ = 75...100 % $U_{o\,nom}$.

$$R_{ext} \approx 4\ k\Omega \bullet \frac{U_o}{U_{o\,nom} - U_o}$$

**or:** Between the R pin and Vo+ to achieve an output voltage range of approximately $U_o$ = 100...105 % $U_{o\,nom}$.

$$R'_{ext} \approx 4\ k\Omega \bullet \frac{(U_o - 2.5\ V)}{2.5\ V \bullet (U_o/U_{o\,nom} - 1)}$$

b) Adjustment by means of an external voltage $U_{ext}$ between Vo– and R pins.

The control voltage range is 1.87...2.62 V and allows for an adjustment in the range of approximately 75...105%.

$$U_{ext} \approx \frac{U_o \bullet 2.5\ V}{U_{o\,nom}}$$

Attempting to adjust the output below this range will cause the converter to shutdown (hiccup mode).

**Note: Applying an external control voltage >2.75 V may damage the converter.**

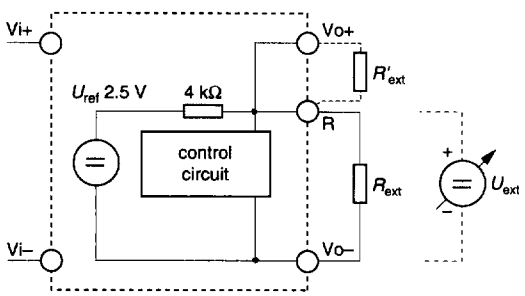



*Fig. 11*
*Output voltage control for single output units by means of the R-input*

*Double output units:*

The R-pin is referenced to the primary side. The figure below shows the circuit topology. Adjustment of the output voltage is possible by means of either an external resistor in the range of 100...105% of $U_{o\,nom}$, or an external voltage source in the range of 75...105% of $U_{o\,nom}$.

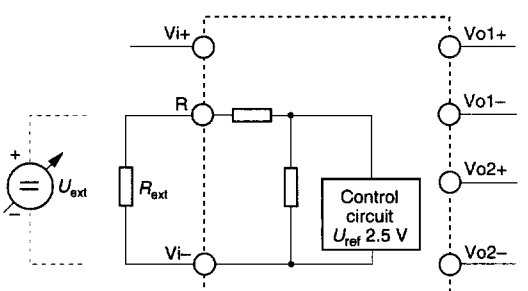



*Fig. 12*
*Output voltage control for double output units by means of the R-input*

a) Adjustment by means of an external resistor.

Programming of the output voltage by means of an external resistor $R_{ext}$ is possible within a limited range of 100...105% of $U_{o\,nom}$. $R_{ext}$ should be connected between the R-pin and Vi–. Connection of $R_{ext}$ to Vi+ may damage the converter. Following table indicates suitable resistor values for typical output voltages under nominal conditions ($U_{i\,nom}$, $I_o$ = 0.5 $I_{o\,nom}$), with either paralleled outputs or equal load conditions on each output.

*Table 11: $R_{ext}$ for $U_o > U_{o\,nom}$; approximate values ($U_{i\,nom}$, $I_{o1,2}$ = 0.5 $I_{o1/2\,nom}$)*

| | $U_{o\,nom}$ | |
|---|---|---|
| $U_o$ [% $U_{o\,nom}$] | 2 × 5 V $R_{ext}$ [kΩ] | 2 × 12/15/24 V $R_{ext}$ [kΩ] |
| 105...108 (107 typically) | 0 | 0 |
| 105 | 18 | 1.5 |
| 104 | 43 | 5.6 |
| 103 | 86 | 12.6 |
| 102 | 175 | 26 |
| 101 | 470 | 68 |
| 100 | ∞ | ∞ |

b) Adjustment by means of an external voltage source $U_{ext}$.

For external output voltage programming in the range 75...105% of $U_{o\,nom}$ a (0...20 V) source $U_{ext}$ is required, connected to the R-pin and Vi–. The table below indicates typical $U_o$ versus $U_{ext}$ values under nominal conditions ($U_{i\,nom}$, $I_o$ = 0.5 $I_{o\,nom}$), with either paralleled outputs or equal load conditions on each output. Applying a control voltage greater than 20 V will set the converter into a hiccup mode. Direct paralleling of the R-pins of units connected in parallel is feasible.

*Table 12: $U_{ext}$ for $U_o$ = 75...105% $U_{o\,nom}$; typical values ($U_{i\,nom}$, $I_{o1,2}$ = 0.5 $I_{o1/2\,nom}$)*

| | $U_{o\,nom}$ | | | |
|---|---|---|---|---|
| $U_o$ [% $U_{o\,nom}$] | 2 × 5 V $U_{ext}$ [V] | 2 × 12 V $U_{ext}$ [V] | 2 × 15 V $U_{ext}$ [V] | 2 × 24 V $U_{ext}$ [V] |
| 105 | 0.5 | 0.07 | 0.37 | 0.25 |
| 102 | 1.68 | 1.43 | 1.64 | 1.60 |
| 95 | 4.60 | 4.60 | 4.60 | 4.60 |
| 85 | 8.74 | 9.22 | 8.92 | 9.23 |
| 75 | 12.84 | 13.64 | 13.28 | 13.75 |

6.1

**Output Voltage Regulation**

Output voltage regulation of single output units:

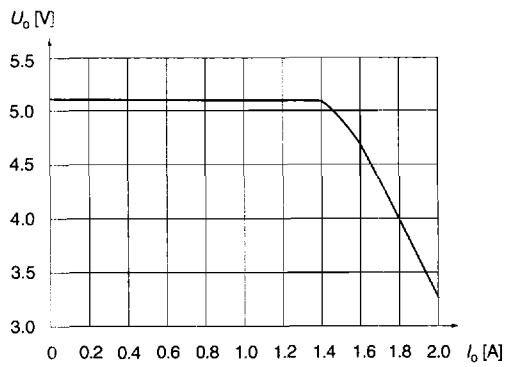



*Fig. 11*
*$U_o$ versus $I_o$ (typ) of single output units with $U_o$ = 5.1 V.*

Load regulation of double output units (2 x 12 V) with outputs independently loaded. Cross load effect is negligible.

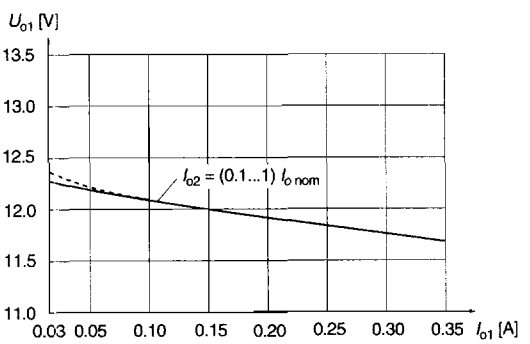



*Fig. 13*
*$U_{o1}$ versus $I_{o1}$ (typ) for various $I_{o2}$*

Output voltage regulation of double output units (2 × 12 V) with output 1 and 2 connected in parallel:

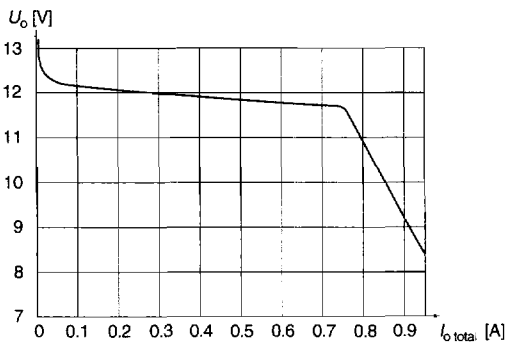



*Fig. 12*
*$U_o$ versus $I_o$ (typ) of double output units, with both outputs in parallel.*

## Immunity to Environmental Conditions

*Table 13: Mechanical stress*

| Test Method | | Standard | Test Conditions | |
|---|---|---|---|---|
| Ca | Damp heat steady state | DIN 40046 part 5<br>IEC 68-2-3 | Temperature:<br>Relative humidity:<br>Duration: | $40^{+2}$ °C<br>$93^{+2/-3}$ °C<br>56 days<br>Unit not operating |
| Cb | Damp heat | EN 50155 | Damp heat:<br>Temperature gradient: | 2 x 25 h<br>3 K/s for $\Delta\delta$ = 40 °C |
| Ea | Shock (half-sinusoidal) | DIN 40046 part 7<br>IEC 68-2-27 | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 100 $g_n$ = 981 m/s$^2$<br>11 ms<br>18 (3 each direction)<br>Unit operating |
| Eb | Continous shock (half-sinusoidal) | DIN 40046 part 26<br>IEC 68-2-29 | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 40 $g_n$ = 392 m/s$^2$<br>6 ms<br>6000 (1000 each direction)<br>Unit operating |
| Fc | Vibration (sinusoidal) | DIN 40046 part 8<br>IEC 68-2-6 | Frequency (1 Oct/min):<br>Maximum vibration amplitude:<br>Acceleratin amplitude:<br>Test duration: | 10...2000 Hz<br>0.35 mm (10...60 Hz)<br>5 $g_n$ = 49 m/s$^2$<br>7.5 h (2.5 h each axis)<br>Unit operating |
| Fda | Random vibration wide band reproducibility high | DIN 40046 part 23<br>IEC 68-2-35 | Frequency band:<br>Accleeration magnitude:<br>Test duration: | 10...2000 Hz<br>5 $g_{rms}$<br>3 h (1 h each axis)<br>Unit not operating |

### Thermal considerations

*Table 14: Temperature specifications, values given are for an air pressure of 800...1200 hPa (800...1200 mbar)*

| Characteristics | | min | max | Unit |
|---|---|---|---|---|
| $T_A$ | Standard operational ambient temperature range -7, (MIL-STD-810D sections 501.2 and 502.2) | –25 | 71 | °C |
| $T_A$ | Extended operational ambient temperature range -8, (MIL-STD-810D sections 501.2 and 502.2) | –40 | 85 | |
| $T_A$ | Extended operational ambient temperature range -9, (MIL-STD-810D sections 501.2 and 502.2) | –40 | 71 | |
| $T_C$ | Standard operational case temperature range -7 | –25 | 95 | |
| $T_C$ | Extended operational case temperature range -8 | –40 | 105 | |
| $T_C$ | Extended operational case temperature range -9 | –40 | 95 | |
| $T_S$ | Storage temperature range -7, (MIL-STD-810D sections 501.2 and 502.2) | –40 | 100 | |
| $T_S$ | Storage temperature range -8, (MIL-STD-810D sections 501.2 and 502.2) | –55 | 105 | |
| $T_S$ | Storage temperature range -9, (MIL-STD-810D sections 501.2 and 502.2) | –55 | 100 | |

*Table 15: MTBF*

| Values at specified Case Temperature | Types | Ground Benign 40°C | Ground Fixed 40°C | Ground Fixed 70°C | Ground Mobile 50°C | Unit |
|---|---|---|---|---|---|---|
| MTBF according to MIL-HDBK-217F, notice 2 | 40 IMX 7-15-15-7 | 1'640'000 | 214'000 | 83'000 | 77'000 | h |
| Device hours | IMX 7 | n.a. | n.a. | | n.a. | |

## Mechanical Data

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

European Projection

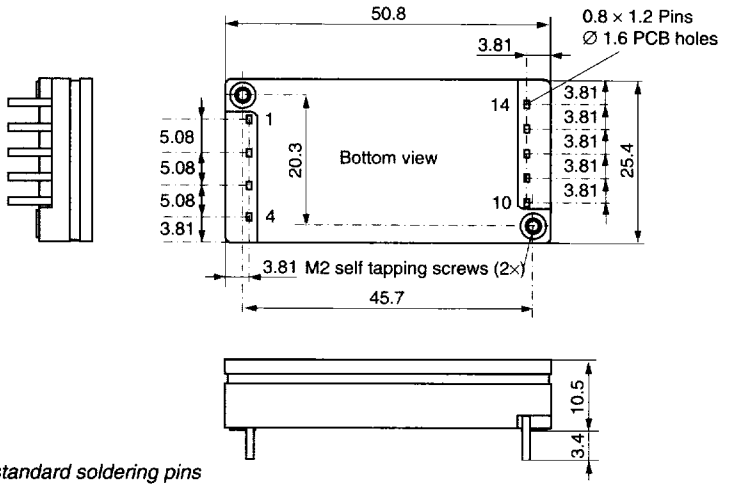



*Fig. 16*
*Case IMX 7 with standard soldering pins*

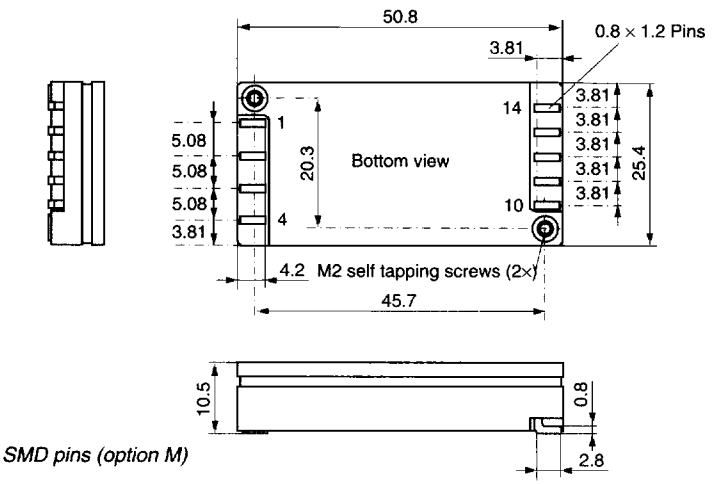



*Fig. 17*
*Case IMX 7 with SMD pins (option M)*

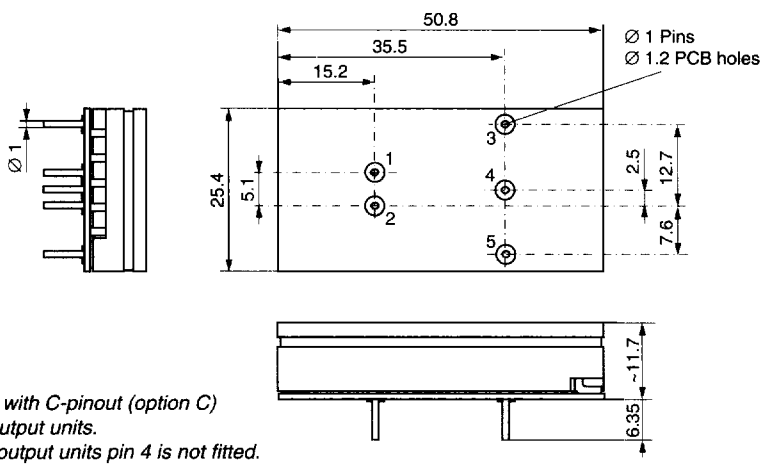
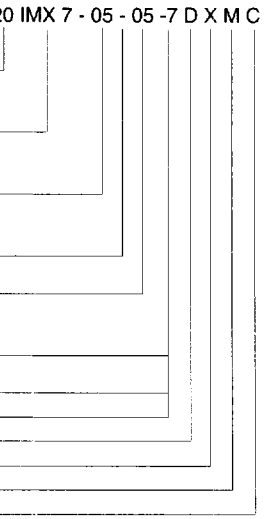



*Fig. 18*
*Case IMX 7 with C-pinout (option C)*
*for double output units.*
*With single output units pin 4 is not fitted.*

## Type Key and Product Marking

### Type Key




Input voltage range $U_i$
- 8.4...36 V DC ..... 20
- 16.8...75 V DC ..... 40
- 40...121 V DC ..... 70

Family ..... IMX 7

Nominal output voltage for output 1 [V DC]
3.3, 5, 5.1, 12, 15, 24

Dash: Designates double output unit with two independent galvanically isolated outputs ..... - [1]

Nominal output voltage for output 2 [V DC] ... 5, 12, 15, 24

Operating ambient temperature range TA
$T_A$ = –25...71 °C ..... -7

Options:
- Extended temperature range –40...85 °C ..... -8 [2]
- Extended temperature range –40...71 °C ..... -9
- Signal Out OK ..... D [3 5]
- LED "Output voltage present" ..... X [4]
- SMD version ..... M [5]
- C-pinout ..... C [2 6]

[1] Not applicable for option C.
[2] Excludes option D.
[3] Available for single output units, excludes option -8.
[4] Only available for double output units.
[5] Excludes option C.
[6] Excludes option M.

6.1

Examples: 40 IMX 7-05-05-7M: DC-DC converter, input voltage range 16.8...75 V, 2 galvanically isolated outputs each providing 5 V, 700 mA, surface mount version.

20 IMX 7-0505-7XC: DC-DC converter, input voltage range 8.4...36 V, C-pinout with outputs ±5 V, 600 mA, equipped with LED indicating output voltage present.

### Product Marking

Main face: Basic type designation, output voltage and current, applicable safety approval and recognition marks, Melcher patent nos. and company logo.

Side label: Date code and serial no.

Bottom: Pin numbers, company logo.