POWER SUPPLY
- AC 200-240V Regional Input
- Cost Optimized without Compromising Quality or Reliability
- Optional with Conformal Coated PC-Boards
- Active PFC
- Width only 49mm
- Efficiency 95.7%
- Full Power Between -25°C and +55°C
- DC-OK Relay Contact Included
- 3 Year Warranty

GENERAL DESCRIPTION
These PIANO series units are extraordinarily compact, industrial grade power supplies that focus on the essential features needed in today's industrial applications. The excellent cost/performance ratio presents many new and exciting opportunities without compromising quality or reliability.

The mechanically robust housing is made of a high-grade, reinforced molded material, which permits the units to be used in surrounding temperatures up to 70°C.

Since typical industrial applications do not require multiple mains inputs, the reduction to a regional input voltage range (AC 200-240V) simplifies the circuitry and has significant advantages for reliability, efficiency and cost.

The addition of a DC-OK signal makes the unit suitable for many industry applications such as: process, automation and many other critical applications where preventive function monitoring can help to avoid long downtimes.

The PIC480.241C-C1 device is the same as the PIC480.241C but with conformal coated pc-boards.

SHORT-FORM DATA
- Output voltage DC 24V
- Adjustment range 24 - 28V
- Output current 20A at 24V, amb < 55°C
  - 15A at 24V, amb < 70°C
  - 17.1A at 28V, amb < 55°C
  - 12.8A at 28V, amb < 70°C
- Output power 480W ambient < 55°C
  - 360W ambient < 70°C
- Output ripple < 100mVpp 20Hz to 20MHz
- AC Input voltage AC 200-240V ±10%
- Mains frequency 50-60Hz ±6%
- AC Input current 2.2A at 230Vac
- Power factor 0.99 at 230Vac
- AC Inrush current 26A peak at 230Vac, 40°C
- Efficiency 95.7% at 230Vac
- Losses 21.6W at 230Vac
- Temperature range -25°C to +70°C operational
- Derating 8W/°C +55 to +70°C
- Hold-up time 30ms at 230Vac
- Dimensions 49x124x124mm WxHxD
- Weight 620g / 1.37lb

ORDER NUMBERS
- Power Supply PIC480.241C PIC480.241C-C1
  - With conformal coated pc-boards
- Accessory YR40.242 PIRD20.241
  - Redundancy module

MARKINGS
- CE
- UL US LISTED
- CB SCHEME IEC 61010-2-201 UL 61010-2-201 IEC 62368

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
The information given in this document is correct to the best of our knowledge and experience at the time of publication. If not expressly agreed otherwise, this information does not represent a warranty in the legal sense of the word. As the state of our knowledge and experience is constantly changing, the information in this data sheet is subject to revision. We therefore kindly ask you to always use the latest issue of this document (available under www.pulspower.com). No part of this document may be reproduced or utilized in any form without our prior permission in writing.

**TERMINOLOGY AND ABBREVIATIONS**

**PE and ☼ symbol**  PE is the abbreviation for Protective Earth and has the same meaning as the symbol ☼.

**Earth, Ground**  This document uses the term “earth” which is the same as the U.S. term “ground”.

**T.b.d.**  To be defined, value or description will follow later.

**AC 230V**  A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included.

E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)

**Vac**  A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.

**50Hz vs. 60Hz**  As long as not otherwise stated, AC 230V parameters are valid at 50Hz mains frequency.

**may**  A key word indicating flexibility of choice with no implied preference.

**shall**  A key word indicating a mandatory requirement.

**should**  A key word indicating flexibility of choice with a strongly preferred implementation.
1. INTENDED USE

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, process control, monitoring, measurement, Audio/Video, information or communication equipment or the like. Do not use this device in equipment where malfunction may cause severe personal injury or threaten human life.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

Without additional measures to reduce the conducted emissions on the output (e.g. by using a filter), the device is not suited to supply a local DC power network in industrial, residential, commercial and light-industrial environments.

2. INSTALLATION INSTRUCTIONS

**WARNING** Risk of electrical shock, fire, personal injury or death.

- Turn power off before working on the device and protect against inadvertent re-powering.
- Do not open, modify or repair the device.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Obey the following installation instructions:

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install device in an enclosure providing protection against electrical, mechanical and fire hazards.

Install the device onto a DIN-rail according to EN 60715 with the input terminals on the bottom of the device.

Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60°C for ambient temperatures up to +45°C, 75°C for ambient temperatures up to +55°C and 90°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection. Unused screw terminals should be securely tightened.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The enclosure of the device provides a degree of protection of IP20. The enclosure does not provide protection against spilled liquids.

The isolation of the device is designed to withstand impulse voltages of overvoltage category III according to IEC 60664-1.

The device is designed as “Class of Protection” I equipment according to IEC 61140. Do not use without a proper PE (Protective Earth) connection.

The device is suitable to be supplied from TN, TT or IT mains networks. The continuous voltage between the input terminals and the PE potential must not exceed 300Vac.

A disconnecting means shall be provided for the input of the device.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid!

The device is designed for altitudes up to 5000m (16400ft). Above 2000m (6560ft) the overvoltage category is reduced to level II and a reduction in output current is required.

Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 5mm left and right side. Increase the 5mm to 15mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5mm can be reduced to zero.

The device is designed, tested and approved for branch circuits up to 20A without additional protection device. For higher branch circuits use an additional protection device. If an external input protection device is utilized, do not use one smaller than a 10A B- or 6A C-characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +70°C (+158°F). The operational temperature is the same as the ambient or surrounding air temperature and is defined 2cm below the device.

The device is designed to operate in areas between 5% and 95% relative humidity.

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
3. AC-INPUT

- **AC input**: nom. AC 200-240V suitable for TN-, TT- and IT mains networks
- **AC input range**: 180-264Vac continuous operation
- 264-300Vac < 500ms
- **Allowed voltage L or N to earth**: max. 300Vac continuous, IEC 62103
- **Input frequency**: nom. 50–60Hz ±6%
- **Turn-on voltage**: typ. 150Vac steady-state value, see Fig. 3-1
- **Shut-down voltage**: typ. 130Vac steady-state value, see Fig. 3-1
- **External input protection**: See recommendations in chapter 23.3.

### Input current
- typ. 2.2A at 24V, 20A, 230Vac, see Fig. 3-3

### Power factor (*)
- typ. 0.99 at 24V, 20A, 230Vac, see Fig. 3-4

### Crest factor (**) 
- typ. 1.6 at 24V, 20A, 230Vac

- **Start-up delay**: typ. 400ms see Fig. 3-2
- **Rise time**: typ. 60ms at 24V, 20A const. current load, 0mF load capacitance, see Fig. 3-2
  - typ. 240ms at 24V, 20A const. current load, 20mF load capacitance, see Fig. 3-2

### Turn-on overshoot 
- max. 200mV resistive load, see Fig. 3-2

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.

**) The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
4. **DC-INPUT**

Do not operate this power supply with DC-input voltage.

5. **INPUT INRUSH CURRENT**

A NTC inrush limiter, which is bypassed by a relay contact during normal operation, limits the input inrush current after turn-on of the input voltage.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inrush current(*)</td>
<td>max. 32A&lt;sub&gt;peak&lt;/sub&gt;</td>
<td>40°C ambient, 230Vac, cold start</td>
</tr>
<tr>
<td></td>
<td>typ. 26A&lt;sub&gt;peak&lt;/sub&gt;</td>
<td>40°C ambient, 230Vac, cold start</td>
</tr>
<tr>
<td></td>
<td>typ. 16A&lt;sub&gt;peak&lt;/sub&gt;</td>
<td>25°C ambient, 230Vac, cold start</td>
</tr>
<tr>
<td>Inrush energy(*)</td>
<td>max. 2.1A·s</td>
<td>40°C ambient, 230Vac, cold start</td>
</tr>
</tbody>
</table>

*) The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

Fig. 5-1  **Input inrush current, typical behavior**

230Vac input, 24V, 20A output, 25°C ambient
6. **OUTPUT**

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>nom.</th>
<th>DC 24V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment range</td>
<td>24-28V</td>
<td>guaranteed</td>
</tr>
<tr>
<td>max.</td>
<td>30V***</td>
<td>at clockwise end position of potentiometer</td>
</tr>
<tr>
<td>typ.</td>
<td>24.1V</td>
<td>±0.2%, at full load, cold unit</td>
</tr>
<tr>
<td>Factory settings</td>
<td>50mV</td>
<td>187-264Vac</td>
</tr>
<tr>
<td>max.</td>
<td>150mV</td>
<td>static value, 0A → 20A; see Fig. 6-1</td>
</tr>
<tr>
<td>Load regulation</td>
<td>max.</td>
<td>100mVpp</td>
</tr>
<tr>
<td>Ripple and noise voltage</td>
<td>max.</td>
<td>20Hz to 20MHz, 50Ohm</td>
</tr>
<tr>
<td>Output current</td>
<td>nom.</td>
<td>20A</td>
</tr>
<tr>
<td>nom.</td>
<td>15A</td>
<td>at 24V, ambient temperature &lt;55°C, see Fig. 6-1</td>
</tr>
<tr>
<td>nom.</td>
<td>17.1A</td>
<td>at 28V, ambient temperature &lt;70°C, see Fig. 6-1</td>
</tr>
<tr>
<td>nom.</td>
<td>12.8A</td>
<td>at 28V, ambient temperature &lt;55°C, see Fig. 6-1</td>
</tr>
<tr>
<td><strong>Output power</strong></td>
<td>nom.</td>
<td>480W</td>
</tr>
<tr>
<td>nom.</td>
<td>360W</td>
<td>ambient temperature &lt;55°C</td>
</tr>
<tr>
<td>Overload behaviour</td>
<td>cont. current</td>
<td>output voltage &gt; 13.5Vdc, see Fig. 6-1</td>
</tr>
<tr>
<td>HiccupPLUS mode**</td>
<td>output voltage &lt; 13.5Vdc, see Fig. 6-1</td>
<td></td>
</tr>
<tr>
<td>Short-circuit current</td>
<td>min.</td>
<td>21A*</td>
</tr>
<tr>
<td>max.</td>
<td>25A*</td>
<td>load impedance 50mOhm, see Fig. 6-1</td>
</tr>
<tr>
<td>typ.</td>
<td>8.1A</td>
<td>average (R.M.S.) current, load impedance 50mOhm, see Fig. 6-1</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>typ.</td>
<td>4 300µF</td>
</tr>
</tbody>
</table>

*) Discharge current of output capacitors is not included.

**) HiccupPLUS Mode
At heavy overloads (when output voltage falls below 13.5V), the power supply delivers continuous output current for 5s. After this, the output is switched off for approx. 8s before a new start attempts with duration of 1s are automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally.

***) This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not guaranteed value which can be achieved. The typical value is about 28.5V.

---

**Fig. 6-1**
Output voltage vs. output current, typ.

**Fig. 6-2**
Short-circuit (50mOhm) on output, HiccupPLUS mode, typ.

---

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
7. HOLD-UP TIME

<table>
<thead>
<tr>
<th>Hold-up Time</th>
<th>typ.</th>
<th>65ms</th>
<th>at 24V, 10A, 230Vac, see Fig. 7-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>55ms</td>
<td>at 24V, 10A, 230Vac, see Fig. 7-1</td>
</tr>
<tr>
<td></td>
<td>typ.</td>
<td>30ms</td>
<td>at 24V, 20A, 230Vac, see Fig. 7-1</td>
</tr>
<tr>
<td></td>
<td>min.</td>
<td>23ms</td>
<td>at 24V, 20A, 230Vac, see Fig. 7-1</td>
</tr>
</tbody>
</table>

**Fig. 7-1 Hold-up time vs. input voltage**

- a) 24V 10A typ.  
- b) 24V 10A min.  
- c) 24V 20A typ.  
- d) 24V 20A min.

**Fig. 7-2 Shut-down behavior, definitions**

- Zero Transition
- - 5%
- Hold-up Time

8. DC-OK RELAY CONTACT

This feature monitors the output voltage, which is produced by the power supply itself. It is independent of a back-fed voltage from a unit connected in parallel to the power supply output (e.g. redundant application).

**Threshold voltage**
- typ. 21.4V (fixed)

**Contact closes**
- As soon as the output voltage reaches 21.4V.

**Contact opens**
- As soon as the output voltage falls below 21.4V.

**Contact ratings**
- max. 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A resistive load
- min. 1mA at 5Vdc  
- min. permissible load

**Isolation voltage**
- See dielectric strength table in section 18.

**Fig. 8-1 DC-ok relay contact behavior**

- Output Voltage
- 21.4V
- open
- closed
9. Efficiency and Power Losses

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>typ.</th>
<th>95.7%</th>
<th>at 24V, 20A, 230Vac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average efficiency</td>
<td>typ.</td>
<td>95.2%</td>
<td>25% at 5A, 25% at 10A, 25% at 15A, 25% at 20A</td>
</tr>
<tr>
<td>Power losses</td>
<td>typ.</td>
<td>1.35W</td>
<td>at 24V, 0A, 230Vac</td>
</tr>
<tr>
<td></td>
<td>typ.</td>
<td>10.7W</td>
<td>at 24V, 10A, 230Vac</td>
</tr>
<tr>
<td></td>
<td>typ.</td>
<td>21.6W</td>
<td>at 24V, 20A, 230Vac</td>
</tr>
</tbody>
</table>

*) The average efficiency is an assumption for a typical application, where the power supply is loaded with 25% of the nominal load for 25% of the time, 50% of the nominal load for another 25% of the time, 75% of the nominal load for another 25% of the time and with 100% of the nominal load for the rest of the time.

10. Lifetime Expectancy and MTBF

<table>
<thead>
<tr>
<th>Lifetime expectancy</th>
<th>93 000h</th>
<th>at 24V, 10A and 40°C, 230Vac</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>264 000h*)</td>
<td>at 24V, 10A and 25°C, 230Vac</td>
</tr>
<tr>
<td></td>
<td>51 000h</td>
<td>at 24V, 20A and 40°C, 230Vac</td>
</tr>
<tr>
<td></td>
<td>144 000h*)</td>
<td>at 24V, 20A and 25°C, 230Vac</td>
</tr>
<tr>
<td>MTBF SN 29500, IEC 61709</td>
<td>482 000h</td>
<td>at 24V, 20A and 40°C, 230Vac</td>
</tr>
<tr>
<td></td>
<td>894 000h</td>
<td>at 24V, 20A and 25°C, 230Vac</td>
</tr>
<tr>
<td>MTBF MIL HDBK 217F</td>
<td>207 000h</td>
<td>at 24V, 20A and 40°C, 230Vac; Ground Benign GB40</td>
</tr>
<tr>
<td></td>
<td>279 000h</td>
<td>at 24V, 20A and 25°C, 230Vac; Ground Benign GB25</td>
</tr>
<tr>
<td></td>
<td>45 000h</td>
<td>at 24V, 20A and 40°C, 230Vac; Ground Fixed GF40</td>
</tr>
<tr>
<td></td>
<td>57 000h</td>
<td>at 24V, 20A and 25°C, 230Vac; Ground Fixed GF25</td>
</tr>
</tbody>
</table>

*) The Lifetime expectancy shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor’s manufacturer specification. The manufacturer of the electrolytic capacitors only guarantees a maximum life of up to 15 years (131 400h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

**) MTBF stands for Mean Time Between Failure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product. The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
11. FUNCTIONAL DIAGRAM

Fig. 11-1 Functional diagram

- Input Fuse
- Input Filter
- Input Rectifier
- Inrush Current Limiter
- PFC Converter
- Power Converter
- Output Filter
- Output Voltage Regulator
- Output Over-Voltage Protection
- Temperature Shut-down
- DC-ok Contact
- DC-ok LED
- V_OUT
- +
- +
- -
- -

12. TERMINALS AND WIRING

The terminals are IP20 finger safe constructed and suitable for field- and factory wiring.

<table>
<thead>
<tr>
<th>Type</th>
<th>Input and output</th>
<th>DC-OK-Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid wire</td>
<td>max. 6mm²</td>
<td>max. 1.5mm²</td>
</tr>
<tr>
<td>Stranded wire</td>
<td>max. 4mm²</td>
<td>max. 1.5mm²</td>
</tr>
<tr>
<td>American Wire Gauge</td>
<td>AWG20-10</td>
<td>AWG28-16</td>
</tr>
<tr>
<td>Maximal wire diameter</td>
<td>2.8mm (including ferrules)</td>
<td>1.6mm (including ferrules)</td>
</tr>
<tr>
<td>Wire stripping length</td>
<td>7mm / 0.28inch</td>
<td>7mm / 0.28inch</td>
</tr>
<tr>
<td>Screwdriver</td>
<td>3.5mm slotted or cross-head No 2</td>
<td>not required</td>
</tr>
<tr>
<td>Recommended tightening torque</td>
<td>1Nm, 9lb.in</td>
<td>not applicable</td>
</tr>
</tbody>
</table>

Instructions:
a) Use appropriate copper cables that are designed for minimum operating temperatures of:
   75°C for ambient up to 55°C and
   90°C for ambient up to 70°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Unused terminal compartments should be securely tightened.
e) Ferrules are allowed.
13. Front Side and User Elements

A Input Terminals (screw terminals)
- N, L Line input
- PE (Protective Earth) input

B Output Terminals (screw terminals, two pins per pole)
- + Positive output
- – Negative (return) output

C Output voltage potentiometer
Guaranteed adjustment range: 24-28V
Factory set: 24.1V

D DC-OK LED (green)
On, when the output voltage is >18V

E DC-OK Relay Contact (push-in terminals)
Description see chapter 8.
14. EMC

The power supply is suitable for applications in industrial environment. A detailed EMC report is available on request.

EMC Immunity

According generic standards: EN 61000-6-1 and EN 61000-6-2

<table>
<thead>
<tr>
<th>Static discharge</th>
<th>EN 61000-4-2</th>
<th>contact discharge</th>
<th>8kV</th>
<th>Criterion A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air discharge</td>
<td>EN 61000-4-2</td>
<td>8kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electromagnetic discharge</td>
<td>EN 61000-4-3</td>
<td>80MHz-2.7GHz</td>
<td>10V/m</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Fast transients (Burst)</td>
<td>EN 61000-4-4</td>
<td>input lines</td>
<td>4kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>output lines</td>
<td>2kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC-OK signal (coupling clamp)</td>
<td>2kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Surge voltage on input</td>
<td>EN 61000-4-5</td>
<td>L → N</td>
<td>2kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L → PE, N → PE</td>
<td>4kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Surge voltage on output</td>
<td>EN 61000-4-5</td>
<td>+ → -</td>
<td>500V</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ / - → PE</td>
<td>1kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Surge voltage on DC-OK</td>
<td>EN 61000-4-5</td>
<td>DC-OK signal → PE</td>
<td>1kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Conducted disturbance</td>
<td>EN 61000-4-6</td>
<td>0.15-80MHz</td>
<td>10V</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Mains voltage dips</td>
<td>EN 61000-4-11</td>
<td>0% of 200Vac</td>
<td>0Vac, 20ms</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40% of 200Vac</td>
<td>80Vac, 200ms</td>
<td>Criterion C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70% of 200Vac</td>
<td>140Vac, 500ms</td>
<td>Criterion C</td>
</tr>
<tr>
<td>Voltage interruptions</td>
<td>EN 61000-4-11</td>
<td>0% of 200Vac (=0V)</td>
<td>5000ms</td>
<td>Criterion C</td>
</tr>
<tr>
<td>Voltage sags</td>
<td>SEMI F47 0706</td>
<td>dips on the input voltage according to SEMI F47 standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>80% of 200Vac (160Vac)</td>
<td>1000ms</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70% of 200Vac (140Vac)</td>
<td>500ms</td>
<td>Criterion C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of 200Vac (100Vac)</td>
<td>200ms</td>
<td>Criterion C</td>
</tr>
<tr>
<td>Powerful transients</td>
<td>VDE 0160</td>
<td>over entire load range</td>
<td>750V, 0.3ms</td>
<td>Criterion A</td>
</tr>
</tbody>
</table>

Criteria:
A: Power supply shows normal operation behavior within the defined limits.
B: Temporary voltage dips possible. No change in operation mode.
C: Temporary loss of function is possible. Power supply may shut-down and restarts by itself. No damage or hazards for the power supply will occur.

EMC Emission

According generic standards: EN 61000-6-3, EN 61000-6-4

| Conducted emission input lines | EN 55011, EN 55032, FCC Part 15, CISPR 11, CISPR 32 | Class B fulfilled |
| Conducted emission output lines**) | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | limits for DC power port according EN 61000-6-3 not fulfilled |
| Radiated emission             | EN 55011, EN 55032 | Class B fulfilled |
| Harmonic input current        | EN 61000-3-2 | Class A fulfilled between 0A and 20A load |
| Voltage fluctuations, flicker | EN 61000-3-3 | fulfilled**) |

This device complies with FCC Part 15 rules.
Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**) tested with constant current loads, non pulsing

**) for information only, not mandatory for EN 61000-6-3

Switching Frequencies

The power supply has two converters with two different switching frequencies included.

Switching frequency 1
40-120kHz PFC converter, input voltage and output power dependent

Switching frequency 2
80-140kHz Main converter, input voltage and output power dependent

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
15. Environment

Operational temperature\textsuperscript{(*)} \(-25°C \text{ to } +70°C \text{ (-13°F to 158°F)}\) reduce output power according Fig. 15-1

Storage temperature \(-40°C \text{ to } +85°C \text{ (-40°F to 185°F)}\) for storage and transportation

Output de-rating 8W/°C 55°C to 70°C (131°F to 158°F)

Humidity\textsuperscript{(**)} 5 to 95% r.h. IEC 60068-2-30

Vibration sinusoidal 2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g\textsuperscript{(***)} IEC 60068-2-6

Shock 30g 6ms, 20g 11ms\textsuperscript{(***)} IEC 60068-2-27

Altitude 0 to 2000m (0 to 6 560ft) without any restrictions

2000 to 6000m (6 560 to 20 000ft) reduce output power or ambient temperature, see Fig. 15-2

Altitude de-rating 30W/1000m or 5°C/1000m > 2000m (6500ft), see Fig. 15-2

Over-voltage category III IEC 62477-1, altitudes up to 2000m

II altitudes from 2000m to 6000m

Degree of pollution 2 IEC 62477-1, not conductive

LABS compatibility The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.

\textsuperscript{(*)} Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.

\textsuperscript{(**)} Do not energize while condensation is present

\textsuperscript{(***)} Tested on a DIN-Rail with a thickness of 1.3mm.

---

*Fig. 15-1 Output current vs. ambient temp.*

*Fig. 15-2 Output current vs. altitude*
# 16. Safety and Protection Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isolation resistance</strong></td>
<td>Min. 500MOhm</td>
</tr>
<tr>
<td></td>
<td>At delivered condition between input and output, measured with 500Vdc</td>
</tr>
<tr>
<td></td>
<td>Min. 500MOhm</td>
</tr>
<tr>
<td></td>
<td>At delivered condition between input and PE, measured with 500Vdc</td>
</tr>
<tr>
<td></td>
<td>Min. 500MOhm</td>
</tr>
<tr>
<td></td>
<td>At delivered condition between output and PE, measured with 500Vdc</td>
</tr>
<tr>
<td></td>
<td>Min. 500MOhm</td>
</tr>
<tr>
<td></td>
<td>At delivered condition between output and DC-OK contacts, measured with 500Vdc</td>
</tr>
<tr>
<td><strong>Output over-voltage protection</strong></td>
<td>Typ. 30.5Vdc</td>
</tr>
<tr>
<td></td>
<td>Max. 32.0Vdc</td>
</tr>
<tr>
<td></td>
<td>In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.</td>
</tr>
<tr>
<td><strong>Class of protection</strong></td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>According to IEC 61140</td>
</tr>
<tr>
<td></td>
<td>A PE (Protective Earth) connection is required</td>
</tr>
<tr>
<td><strong>Ingress protection</strong></td>
<td>IP 20</td>
</tr>
<tr>
<td></td>
<td>According to EN/IEC 60529</td>
</tr>
<tr>
<td><strong>Over-temperature protection</strong></td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>Output shut-down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen e.g. when ambient temperature is too high, ventilation is obstructed or the de-rating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.</td>
</tr>
<tr>
<td><strong>Input transient protection</strong></td>
<td>MOV (Metal Oxide Varistor)</td>
</tr>
<tr>
<td></td>
<td>For protection values see chapter Fehler! Verweisquelle konnte nicht gefunden werden. (EMC).</td>
</tr>
<tr>
<td><strong>Internal input fuse</strong></td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>Not user replaceable slow-blow high-braking capacity fuse</td>
</tr>
<tr>
<td><strong>Touch current (leakage current)</strong></td>
<td>Typ. 0.33mA / 0.69mA</td>
</tr>
<tr>
<td></td>
<td>Max. 0.43mA / 0.89mA</td>
</tr>
<tr>
<td></td>
<td>At 230Vac, 50Hz, TN-, TT-mains / IT-mains</td>
</tr>
<tr>
<td></td>
<td>At 264Vac, 50Hz, TN-, TT-mains / IT-mains</td>
</tr>
</tbody>
</table>
17. **Dielectric Strength**

The output voltage is floating and has no ohmic connection to the ground. Type and factory tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment, which applies the voltage with a slow ramp (2s up and 2s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

![Fig. 17-1 Dielectric strength]

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type test</td>
<td>60s</td>
<td>2500Vc</td>
<td>3000Vc</td>
<td>500Vc</td>
</tr>
<tr>
<td>Factory test</td>
<td>5s</td>
<td>2500Vc</td>
<td>2500Vc</td>
<td>500Vc</td>
</tr>
<tr>
<td>Field test</td>
<td>5s</td>
<td>2000Vc</td>
<td>2000Vc</td>
<td>500Vc</td>
</tr>
<tr>
<td>Cut-off current setting</td>
<td>10mA</td>
<td>10mA</td>
<td>10mA</td>
<td>1mA</td>
</tr>
</tbody>
</table>

To fulfil the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the – pole or any other part of the output circuit shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

B*) When testing input to DC-OK ensure that the max. voltage between DC-OK and the output is not exceeded (column D). We recommend connecting DC-OK pins and the output pins together when performing the test.
18. Approvals and Fulfilled Standards

UL 61010
- UL Certificate
  - Listed equipment for category NMTR - UL 61010-2-201 Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
  - Applicable for US and Canada
  - E-File: E198865

IECE 61010
- CB Scheme Certificate
  - IEC 61010-2-201 Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment

IECE 62368
- CB Scheme Certificate
  - IEC 62368-1 Audio/video, information and communication technology equipment - Safety requirements
  - Output safety level: ES1

ISA-71.04-1985
- Manufacturer’s Declaration (Online Document)
  - Airborne Contaminants Corrosion Test
  - Severity Level: G3 Harsh
  - H2S: 100ppb
  - NOx: 1250ppb
  - Cl2: 20ppb
  - SO2: 300ppb
  - Test Duration: 3 weeks, which simulates a service life of at least 10 years

VDMA 24364
- LABS
  - Paint Wetting Impairment Substances Test (or LABS-Test)
  - Tested for Zone 2 and test class C1 according to VDMA 24364-C1-L/W for solvents and water-based paints

19. Regulatory Compliance

EU Declaration of Conformity
- The CE mark indicates conformance with the
  - EMC directive
  - Low-voltage directive
  - RoHS directive

REACH Directive
- Manufacturer’s Statement
  - EU-Directive regarding the Registration, Evaluation, Authorization and Restriction of Chemicals

WEEE Directive
- Manufacturer’s Statement
  - EU-Regulation on Waste Electrical and Electronic Equipment Registered in Germany as business to business (B2B) products.

RoHS (China RoHS 2)
- Manufacturer’s Statement
  - Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products
  - 25 years

EAC TR Registration
- EAC Certificate
  - EAC EurAsian Conformity - Registration Russia, Kazakhstan and Belarus
  - 8504408200, 8504409000
## 20. Physical Dimensions and Weight

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>49mm / 1.93”</td>
</tr>
<tr>
<td>Height</td>
<td>124mm / 4.88”</td>
</tr>
<tr>
<td>Depth</td>
<td>124mm / 4.88”</td>
</tr>
<tr>
<td><strong>Note:</strong> The DIN-rail height must be added to the unit depth to calculate the total required installation depth.</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>620g / 1.37lb</td>
</tr>
<tr>
<td>DIN-Rail</td>
<td>Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.</td>
</tr>
<tr>
<td>Plastic Material of Housing</td>
<td>Flame retardant Polycarbonate (PC) - UL94-V0</td>
</tr>
<tr>
<td></td>
<td>Vicat softening temperature specified with 149°C according to ASTM D1525</td>
</tr>
<tr>
<td>Installation Clearances</td>
<td>See chapter 2</td>
</tr>
</tbody>
</table>

![Fig. 20-1 Front view](image1)

![Fig. 20-2 Side view](image2)

---

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN
All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
21. Accessory

21.1. YR40.242 Redundancy Module

The YR40.242 is the preferred redundancy module for PIC480.241C power supplies. It is equipped with two input channels (20A each), which are individually decoupled by utilizing MOSFET technology. The output current can go as high as 40A.

Using MOSFETs instead of diodes reduces the heat generation and the voltage drop between input and output.

The YR40.242 does not require an additional auxiliary voltage.

Due to the low power losses, the unit is very slender and only requires 36mm width on the DIN-rail.

See chapter 22.5 for instructions how to build a redundant system.

21.2. PIRD20.241 Redundancy Module

The PIRD20.241 is a very cost effective diode redundancy module, which can be used to build 1+1 and N+1 redundant systems. It is equipped with two input channels, which can be connected to power supplies with up to 10A output current and one output, which can carry nominal currents up to 20A.

If 20A power supplies are utilized, it is recommended to connect the power supply output to both inputs of the redundancy module. Therefore, two redundancy modules are required to build a 20A redundant power system.

The PIRD20.241 is the perfect solution to use in a redundant system, if the power supply itself is equipped with a DC-OK signal.

The PIRD20.241 does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

See chapter 22.5 for instructions how to build a redundant system.
22. APPLICATION NOTES

22.1. BACK-FEEDING LOADS
Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).
This power supply is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off.
The maximum allowed feed-back-voltage is 35Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 6.

22.2. EXTERNAL INPUT PROTECTION
The unit is tested and approved for branch circuits up to 30A (UL) and 32A (IEC). An external protection is only required if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.
If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 10A B- or 6A C-Characteristic breaker should be used.

22.3. PARALLEL USE TO INCREASE OUTPUT POWER
Do not use the power supply in parallel to increase the output power.

22.4. PARALLEL USE FOR 1+1 REDUNDANCY
Power supplies can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one power supply unit fails. The simplest way is to put two power supplies in parallel. This is called a 1+1 redundancy. In case one power supply unit fails, the other one is automatically able to support the load current without any interruption.

Please note: This simple way to build a redundant system does not cover failures such as an internal short circuit in the secondary side of the power supply. In such a case, the defect unit becomes a load for the other power supplies and the output voltage can not be maintained any more. This can only be avoided by utilizing decoupling diodes which are included in the redundancy module YR40.241.

Recommendations for building redundant power systems:

a) Monitor the individual power supply units. Therefore, use the DC-OK relay contact of the PIC480.241C power supply.
b) Use separate input fuses for each power supply.
c) Use separate mains systems for each power supply whenever it is possible.
d) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.
22.5. **Series Operation**

Power supplies of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching.

Earthing of the output is required when the sum of the output voltage is above 60Vdc.

Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

22.6. **Inductive and Capacitive Loads**

The unit is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or “UltraCaps”) with a capacitance larger than 1.5F are connected to the output, the unit might charge the capacitor in the HiccupPLUS mode (see chapter 6).

22.7. **Charging of Batteries**

Do not use the power supply to charge batteries.

22.8. **Operation on Two Phases**

The power supply can also be used on two-phases of a three-phase-system. Such a phase-to-phase connection is allowed as long as the supplying voltage is below 240V+10%.

22.9. **Use in a Tightly Sealed Enclosure**

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. In such situations, the inside temperature defines the ambient temperature for the power supply.

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

| Enclosure: | Rittal Type IP66 Box PK 9519 100, plastic, 180x180x165mm |
| Input: | 230Vac |
| Load: | 24V, 16A; (=80%) load is placed outside the box |
| Temperature inside the box: | 51.5°C (in the middle of the right side of the power supply with a distance of 1cm) |
| Temperature outside the box: | 25.5°C |
| Temperature rise: | 26.0K |

Mar. 2021 / Rev. 1.2 DS-PIC480.241C-EN

All parameters are typical values specified at 24V, 20A output, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.