PIC480.241C

PIANO-Series

24V, 20A, SINGLE PHASE INPUT

POWER SUPPLY

- AC 200-240V Regional Input
- Cost Optimized without Compromising Quality or Reliability
- Width only 49mm
- Efficiency 95.7%
- Full Power Between -10°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.

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	typ. 28A peak	at 230Vac, 40°C
Efficiency	95.7%	at 230Vac
Losses	21.6W	at 230Vac
Temperature range	-10°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**	24-28V Standard unit with DC-OK contact
Accessory	YR40.242	Redundancy module
	PIRD20.241	Redundancy module

MARKINGS

c UL US LISTED IND. CONT. EQ.
UL 508 planned

c TÜV US
UL 60950-1 planned

CE
EMC, LVD

INDEX

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth 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)
230Vac	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 the general professional use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this power supply in equipment, where malfunction may cause severe personal injury or threaten human life.

2. INSTALLATION REQUIREMENTS

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.

Mount the unit on a DIN-rail so that the input terminals are located on the bottom of the unit.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 15%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another power supply).

A disconnecting means shall be provided for the output of the power supplies when used in applications according to CSA C22.2 No 107.1-01.

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

- Do not use the power supply without proper grounding (Protective Earth).
- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering 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 surfaces may cause burns.

3. AC-INPUT

AC input	nom.	AC 200-240V	suitable for TN-, TT- and IT mains networks
AC input range	min.	180-264Vac	continuous operation
	min.	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.	152Vac	steady-state value, see Fig. 3-1
Shut-down voltage	typ.	142Vac	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.

Fig. 3-1 **Input voltage range, typ.**

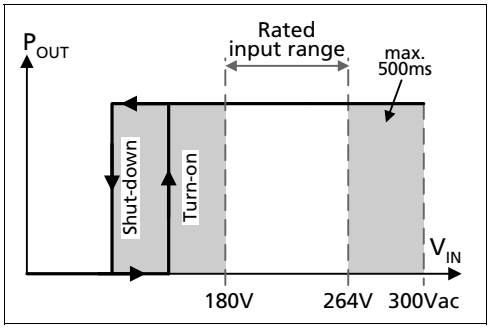


Fig. 3-2 **Turn-on behavior, definitions**

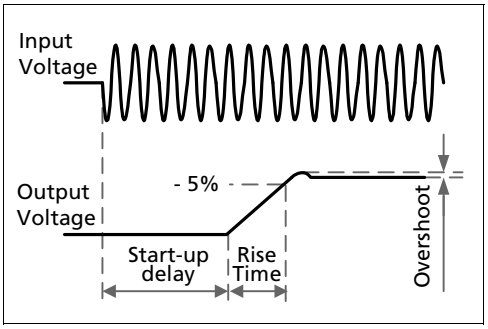


Fig. 3-3 **Input current vs. output load at 24V**

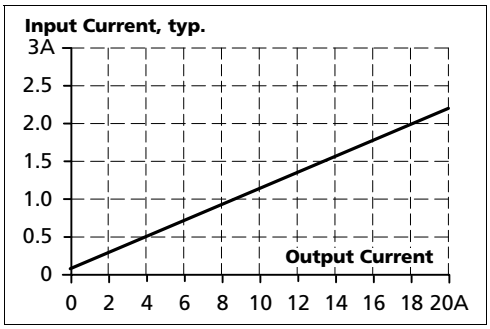
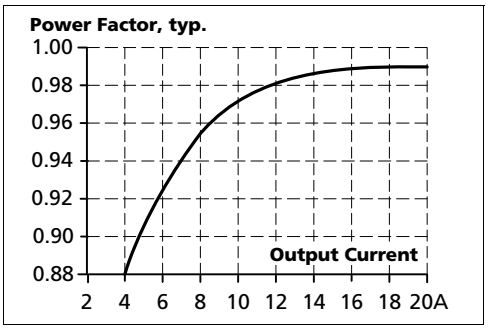


Fig. 3-4 **Power factor vs. output load**



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.

Inrush current*)	max.	$35A_{peak}$	40°C ambient, 230Vac, cold start
	typ.	$26A_{peak}$	40°C ambient, 230Vac, cold start
	typ.	$19A_{peak}$	25°C ambient, 230Vac, cold start
Inrush energy*)	max.	$2.1A^2s$	40°C ambient, 230Vac, cold start

*) 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**

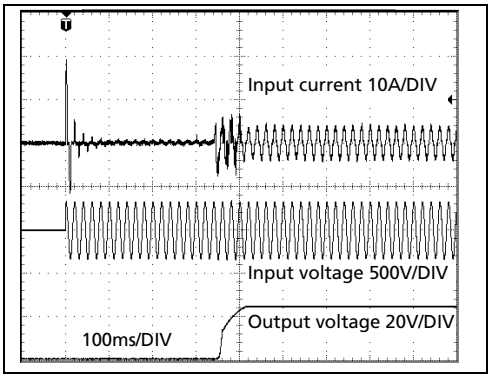
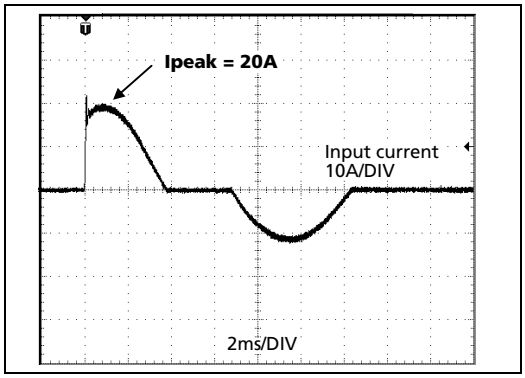


Fig. 5-2 **Input inrush current, zoom into first peak 230Vac input, 24V, 20A output, 25°C ambient**



6. OUTPUT

Output voltage	nom.	DC 24V	
Adjustment range	min.	24-28V	guaranteed
	max.	30V***)	at clockwise end position of potentiometer
Factory settings	typ.	24.1V	±0.2%, at full load, cold unit
Line regulation	max.	50mV	187-264Vac
Load regulation	max.	150mV	static value, 0A → 20A; see Fig. 6-1
Ripple and noise voltage	max.	100mVpp	20Hz to 20MHz, 50Ohm
Output current	nom.	20A	at 24V, ambient temperature <55°C, see Fig. 6-1
	nom.	15A	at 24V, ambient temperature <70°C, see Fig. 6-1
	nom.	17.1A	at 28V, ambient temperature <55°C, see Fig. 6-1
	nom.	12.8A	at 28V, ambient temperature <70°C, see Fig. 6-1
Output power	nom.	480W	ambient temperature <55°C
	nom.	360W	ambient temperature <70°C
Overload behaviour		cont. current	output voltage > 13Vdc, see Fig. 6-1
		Hiccup^{PLUS} mode**)	output voltage < 13Vdc, see Fig. 6-1
Short-circuit current	min.	21A*)	load impedance 50mOhm, see Fig. 6-1
	max.	25A*)	load impedance 50mOhm, see Fig. 6-1
	typ.	8.1A	average (R.M.S.) current, load impedance 50mOhm, see Fig. 6-1
Output capacitance	typ.	4 300µF	included inside the power supply

*) Discharge current of output capacitors is not included.

**) Hiccup^{PLUS} 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.

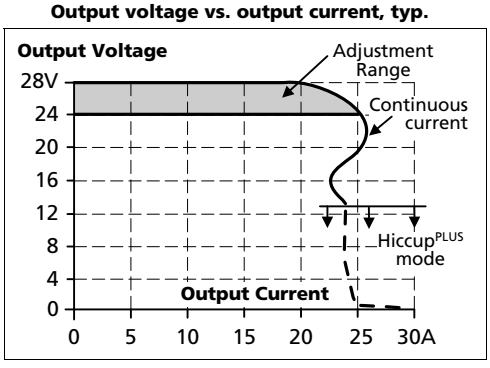
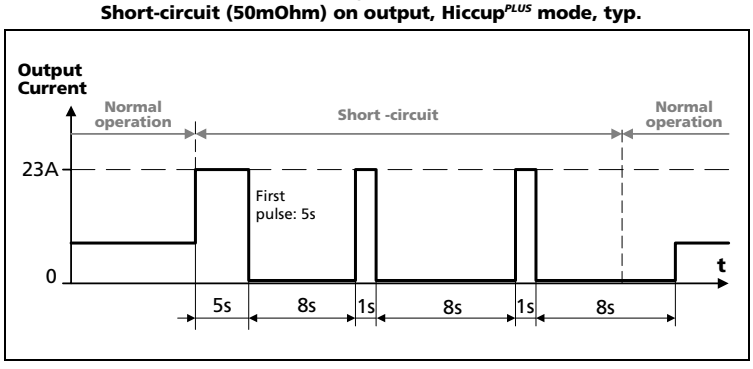


Fig. 6-2
Short-circuit (50mOhm) on output, Hiccup^{PLUS} mode, typ.



7. HOLD-UP TIME

Hold-up Time	typ.	65ms	at 24V, 10A, 230Vac, see Fig. 7-1
	min.	55ms	at 24V, 10A, 230Vac, see Fig. 7-1
	typ.	30ms	at 24V, 20A, 230Vac, see Fig. 7-1
	min.	23ms	at 24V, 20A, 230Vac, see Fig. 7-1

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

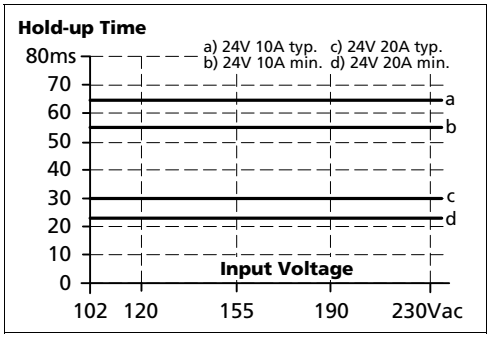
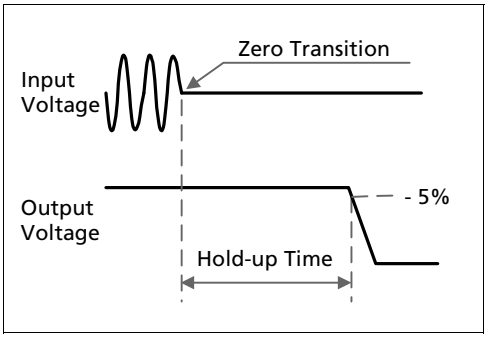


Fig. 7-2 **Shut-down behavior, definitions**

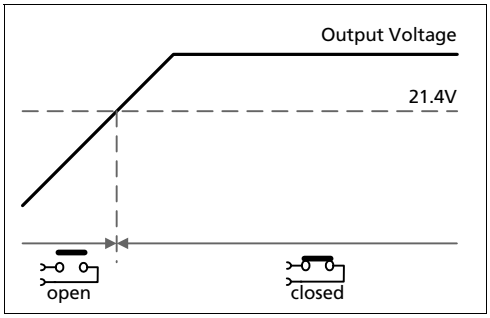


8. DC-OK RELAY CONTACT

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**



9. EFFICIENCY AND POWER LOSSES

Efficiency	typ.	95.7%	at 24V, 20A, 230Vac
Average efficiency*)	typ.	95.2%	25% at 5A, 25% at 10A, 25% at 15A. 25% at 20A
Power losses	typ.	1.35W	at 24V, 0A, 230Vac
	typ.	10.7W	at 24V, 10A, 230Vac
	typ.	21.6W	at 24V, 20A, 230Vac

*) 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.

Fig. 9-1 **Efficiency vs. output current at 24V, typ.**

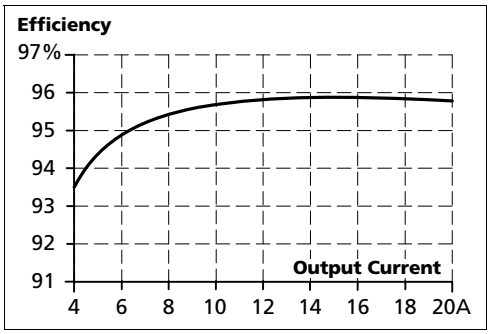
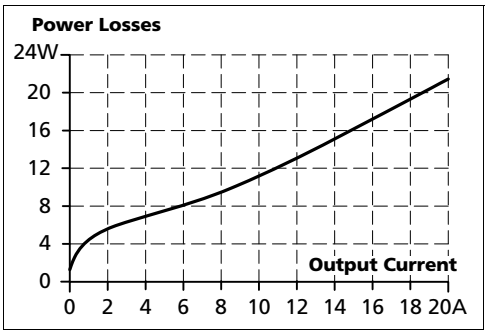


Fig. 9-2 **Losses vs. output current at 24V, typ.**



10. LIFETIME EXPECTANCY AND MTBF

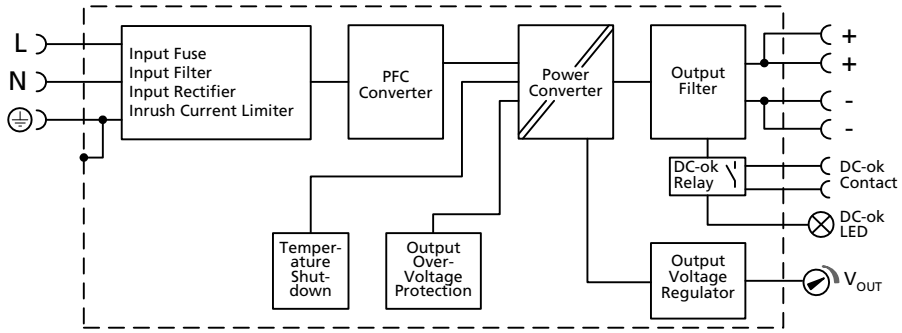
Lifetime expectancy*)	93 000h	at 24V, 10A and 40°C, 230Vac
	264 000h*)	at 24V, 10A and 25°C, 230Vac
	51 000h	at 24V, 20A and 40°C, 230Vac
	144 000h*)	at 24V, 20A and 25°C, 230Vac
MTBF**) SN 29500, IEC 61709	T.B.D.	at 24V, 20A and 40°C, 230Vac
	T.B.D.	at 24V, 20A and 25°C, 230Vac
MTBF**) MIL HDBK 217F	T.B.D.	at 24V, 20A and 40°C, 230Vac; Ground Benign GB40
	T.B.D.	at 24V, 20A and 25°C, 230Vac; Ground Benign GB25
	T.B.D.	at 24V, 20A and 40°C, 230Vac; Ground Fixed GF40
	T.B.D.	at 24V, 20A and 25°C, 230Vac; Ground Fixed GF25

*) 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 **M**ean **T**ime **B**etween **F**ailure, 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.

11. FUNCTIONAL DIAGRAM

Fig. 11-1 **Functional diagram**



12. TERMINALS AND WIRING

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

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

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) Do not use the unit without PE connection.
e) Unused terminal compartments should be securely tightened.
f) Ferrules are allowed.

13. FRONT SIDE AND USER ELEMENTS

Fig. 13-1 **Front side**

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

Criterions:
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 55022, FCC Part 15, CISPR 11, CISPR 22	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 55022	Class B fulfilled
Harmonic input current	EN 61000-3-2	Class A fulfilled between 0A and 20A load Class C fulfilled between 7A 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, output voltage and output power dependent

15. ENVIRONMENT

Operational temperature*)	-10°C to +70°C (14°F to 158°F)	reduce output power according Fig. 15-1
Storage temperature	-40°C to +85°C (-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**)	5 to 95% r.h.	IEC 60068-2-30
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g***) 2 hours / axis***)	IEC 60068-2-6
Shock	30g 6ms, 20g 11ms***) 3 bumps / direction, 18 bumps in total	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 IEC 62103, EN 50178, overvoltage category II
Altitude de-rating	30W/1000m or 5°C/1000m	> 2000m (6500ft), see Fig. 15-2
Over-voltage category	III	IEC 62103, EN 50178, altitudes up to 2000m
	II	altitudes from 2000m to 6000m
Degree of pollution	2	IEC 62103, EN 50178, not conductive
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	

*) Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.
**) Do not energize while condensation is present
***) Tested on a DIN-Rail with a thickness of 1.3mm.

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

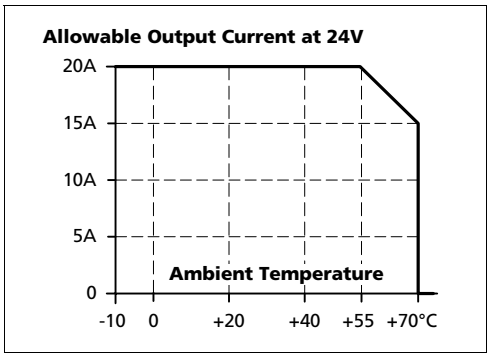
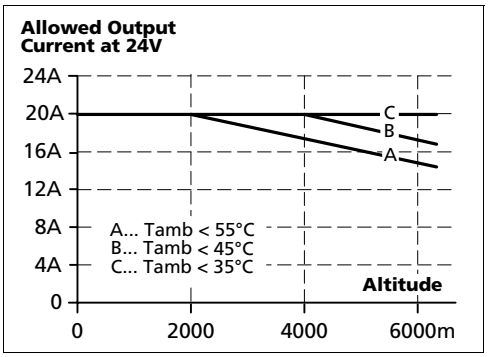


Fig. 15-2 **Output current vs. altitude**



16. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits*)	
Output over-voltage protection	typ. 30.5Vdc max. 32.0Vdc	In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Degree of protection	IP 20	EN/IEC 60529 Caution: For use in a controlled environment according to CSA 22.2 No 107.1-01.
Over-temperature protection	yes	Output shut-down with automatic restart
Input transient protection	MOV (Metal Oxide Varistor)	
Internal input fuse	included	not user replaceable

*) In case of a protection event, audible noise may occur.

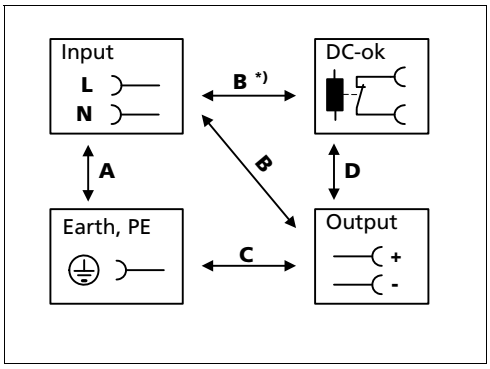
17. SAFETY FEATURES

Input / output separation	SELV	IEC/EN 60950-1
	PELV	IEC/EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41
	double or reinforced insulation	
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 5MOhm	input to output, 500Vdc
Touch current (leakage current)	0.33mA / 0.69mA	230Vac, 50Hz, TN-,TT-mains / IT-mains
	0.43mA / 0.89mA	264Vac, 50Hz, TN-,TT-mains / IT-mains

18. 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. 18-1 **Dielectric strength**



		A	B	C	D
Type test	60s	2500Vac	3000Vac	500Vac	500Vac
Factory test	5s	2500Vac	2500Vac	500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac	500Vac
Cut-off current setting		10mA	10mA	10mA	1mA

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.

19. APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the EMC directive and the Low-voltage directive (LVD).
IEC 60950-1 2nd Edition, planned	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 60950-1 2nd Edition, planned	c UL us	Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); E-File: E137006 Applicable for altitudes up to 2000m.
UL 508, planned	c UL us LISTED IND. CONT. EQ.	Listed for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: E198865

20. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 1st, 2007 regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

21. PHYSICAL DIMENSIONS AND WEIGHT

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

Fig. 21-1 **Front view**

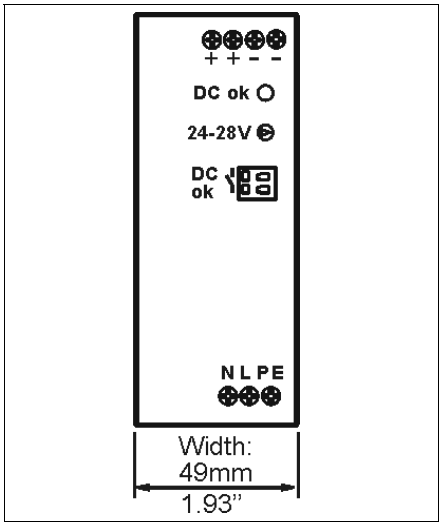
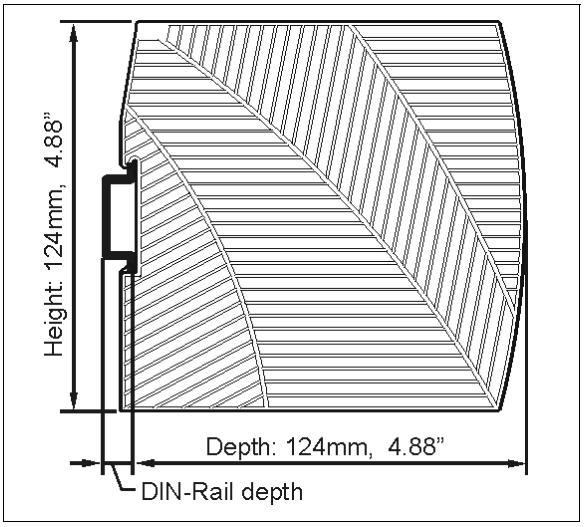


Fig. 21-2 **Side view**



22. ACCESSORY

22.1. YR40.242 REDUNDANCY MODULE

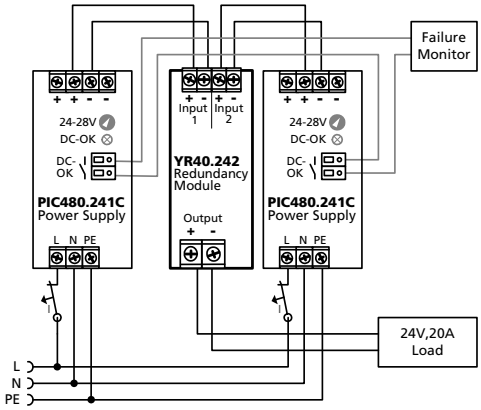
The YR40.242 is the preferred redundancy module for PIC480.241C power supplies. It is equipped with two input channels (20A each), which are individually decoupled by utilizing MOSFET technology. The output current can go as high as 40A.

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 23.5 for instructions how to build a redundant system.



22.2. PIRD20.241 REDUNDANCY MODULE

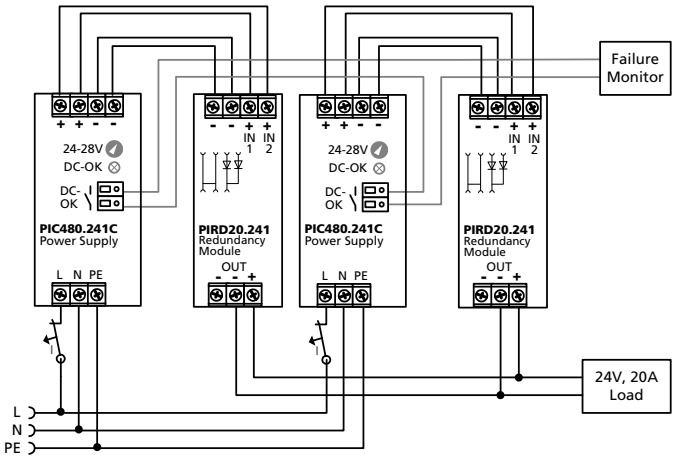
The PIRD20.241 is a very cost effective diode redundancy module, which can be used to build 1+1 and N+1 redundant systems. It is equipped with two input channels, which can be connected to power supplies with up to 10A output current and one output, which can carry nominal currents up to 20A.

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 23.5 for instructions how to build a redundant system.



23. APPLICATION NOTES

23.1. PEAK CURRENT CAPABILITY

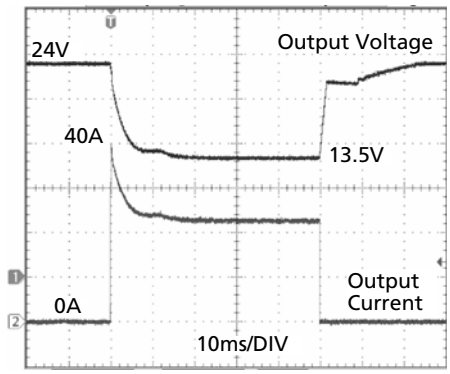
The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

This helps to start current demanding loads. Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current. The same situation applies when starting a capacitive load.

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of over-current to open in a timely manner. This avoids voltage loss in adjacent circuits.

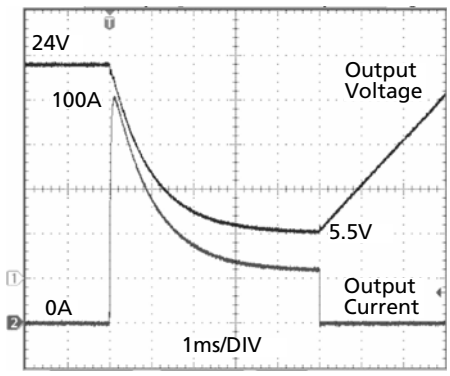
The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 23-1 **Peak load with 2x the nominal current for 50ms, typ.**



40A Peak load (resistive) for 50ms
Output voltage dips from 24V to 14V.

Fig. 23-2 **Peak load with 5x the nominal current for 5ms, typ.**



100A Peak load (resistive) for 5ms
Output voltage dips from 24V to 4V.

Peak current voltage dips	typ.	from 24V to 13.5V	at 40A for 50ms, resistive load
	typ.	from 24V to 7.5V	at 100A for 2ms, resistive load
	typ.	from 24V to 5.5V	at 100A for 5ms, resistive load

23.2. 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.

23.3. 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.

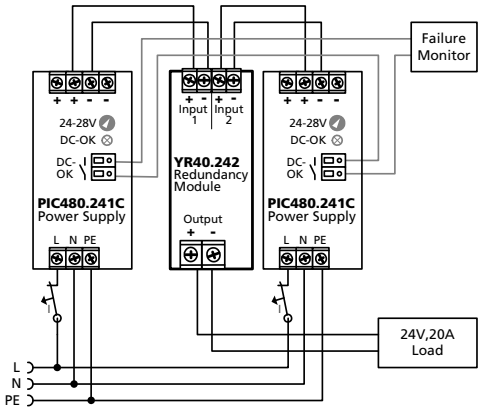
23.4. PARALLEL USE TO INCREASE OUTPUT POWER

Do not use the power supply in parallel to increase the output power.

23.5. 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:

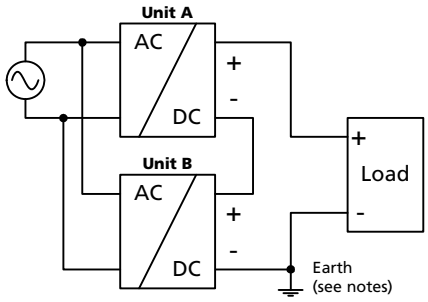
a) Monitor the individual power supply units. Therefore, use the DC-OK relay contact of the PIC480.241C power supply.

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.

23.6. 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.

23.7. INDUCTIVE AND CAPACITIVE LOADS

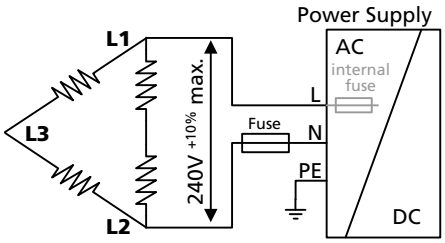
The unit is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "UltraCaps") with a capacitance larger than 1.5F are connected to the output, the unit might charge the capacitor in the Hiccup^{PLUS}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

23.8. CHARGING OF BATTERIES

Do not use the power supply to charge batteries.

23.9. 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$^{+10\%}$.



23.10. 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.

The power supply is placed in the middle of the box; no other heat producing items are inside the box.

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