PULS

DIMENSION **Q-Series**

QT40.241

24V, 40A, THREE PHASE INPUT

POWER SUPPLY

- 3AC 380-480V Wide-range Input
- Width only 110mm
- Efficiency up to 95,3%
- Excellent Partial Load Efficiency
- 150% (1440W) Peak Load Capability
- Easy fuse tripping Due to High Overload Current
- Active Power Factor Correction (PFC)
- Active Filtering of Input Transients
- Minimal Inrush Current Surge
- Three Input Fuses Included
- Current Sharing Feature for Parallel Use
- Full Power Between -25°C and +60°C
- DC-OK Relay Contact, Shut-down Input
- 3 Year Warranty

1. GENERAL DESCRIPTION

The most outstanding features of the the DIMENSION Q-Series DIN-rail power supplies are the extremely high efficiencies and the small sizes, which are achieved by a synchronious rectification and other technological designs.

Large power reserves of 150% support the starting of heavy loads such as DC-motors or capacitive loads. In many cases this allows the use of a unit from a lower wattage class which saves space and money.

High immunity to transients and power surges as well as low electromagnetic emission makes usage in nearly every environment possible.

The integrated output power manager and near zero input inrush current make installation and usuage simple. Diagnostics are easy due to the DC-ok relay, a green DC-OK LED and the red overload LED.

A large intenational approval package for a variety of applications makes this unit suitable for nearly every application.

2. SHORT-FORM DATA

Output voltage	DC 24V	
Adjustment range	24-28V	
Output current	40 – 34.3A	continuous
	60 – 51.5A	for typ. 4s
Output power	960W	continuous
	1440W	for typ. 4s
Output ripple	< 100mVpp	20Hz to 20MHz
Input voltage	AC 380-480V	-15%/+20%
Mains frequency	50-60Hz	±6%
AC Input current	1.65 / 1.35A	at 3x400 / 480Vac
Power factor	0.88 / 0.9	at 3x400 / 480Vac
AC Inrush current	typ. 4.5A peak	
Efficiency	95.3 / 95.2%	at 3x400 / 480Vac
Losses	47.3 / 48.4W	at 3x400 / 480Vac
Temperature range	-25°C to +70°C	operational
Derating	24W/°C	+60 to +70°C
Hold-up time	typ. 25 / 25ms	at 3x400 / 480Vac
Dimensions	110x124x127mm	WxHxD

3. ORDER NUMBERS

Power Supply	**QT40.241**	24-28V Standard unit
Accessory	ZM2.WALL	Wall mount bracket
	SLR01	Redundancy module
	UF20.241	Buffer module

4. MARKINGS

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

c US
UL 60950-1

c US
Class I Div 2
pending

SEMI F47, pending

CE
EMC, LVD

GL
Marine, pending

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INTENDED USE

The power supply shall only be installed and put into operation by qualified personnel.

This power supply is designed for installation in an enclosure and is intended for the general use, such as in industrial control, office, communication, and instrumentation equipment. Do not use this device in aircraft, trains and nuclear equipment, where malfunctioning of the power supply may cause severe personal injury or threaten human life.

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 400V	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)
400Vac	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 380V and AC 400V parameters are valid at 50Hz and AC 480V parameters are valid at 60Hz mains frequency.

DISCLAIMER

The information presented in this document is believed to be accurate and reliable and may change without notice.

5. AC-INPUT

AC input	nom.	3AC 380-480V	wide-range input, TN-, TT-, IT-Mains, see **Fig. 5-1**
AC input range	min.	3x 323-576Vac	continuous operation for an operation on only two legs of a three phase system see section 28.7
Allowed voltage phase to earth	max.	300Vac	consult factory if one phase is earthed
Input frequency	nom.	50–60Hz	±6%
Turn-on voltage	typ.	3x 305Vac	steady-state value, see **Fig. 5-1**
Shut-down voltage	typ.	3x 275Vac	steady-state value, see **Fig. 5-1**

		3AC 400V	**3AC 480V**	
Input current per phase	typ.	1.65A	1.35A	at 24V, 40A, equal phase voltages, see **Fig. 5-3**
Power factor *)	typ.	0.88	0.90	at 24V, 40A, see **Fig. 5-4**
Start-up delay	typ.	500ms	600ms	see **Fig. 5-2**
Rise time	typ.	30ms	30ms	0mF, 24V, 40A, see **Fig. 5-2**
	typ.	40ms	40ms	40mF, 24V, 40A, see **Fig. 5-2**
Turn-on overshoot	max.	200mV	200mV	see **Fig. 5-2**

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

Fig. 5-1 **Input voltage range**

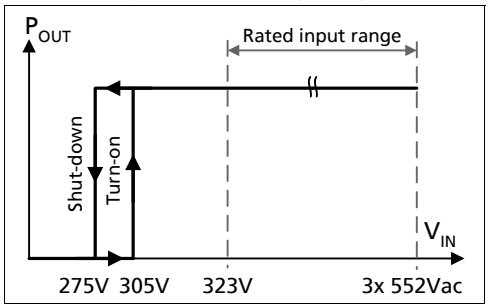


Fig. 5-2 **Turn-on behavior, definitions**

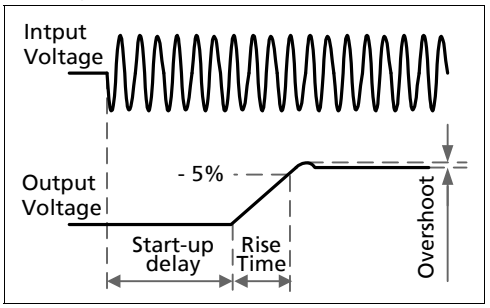


Fig. 5-3 **Input current vs. output load at 24V**

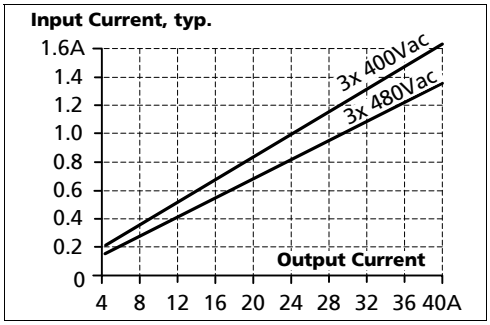
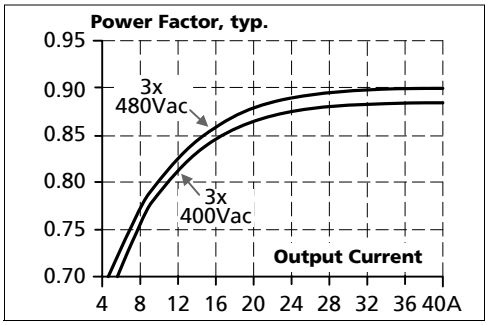


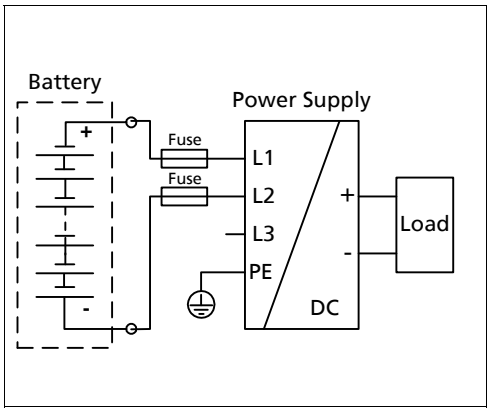
Fig. 5-4 **Power factor vs. output load**



6. DC-INPUT

DC input	nom.	**DC 600V**	
DC input range	min.	450-800Vdc	continuous operation
DC input current	typ.	2.3A / 1.3A	450Vdc / 800Vdc, 24V, 40A
Turn-on voltage	typ.	425Vdc	steady state value
Shut-down voltage	typ.	375Vdc	steady state value

Fig. 6-1 **Wiring for use with DC Input Voltages**



Instructions for DC use:

a) Use a battery or similar DC source.
For other sources contact PULS

b) Connect +pole to L1 and –pole to L2.

c) Terminal L3 remains unused, terminal screw of L3 must be securely tightened.

d) Use appropriate external fuses in the + and – lines which are suitable for the DC-voltage.

e) Connect the PE terminal to a earth wire or to the machine ground.

f) DC-operation is not included in the UL approval. Additional testing might be necessary.

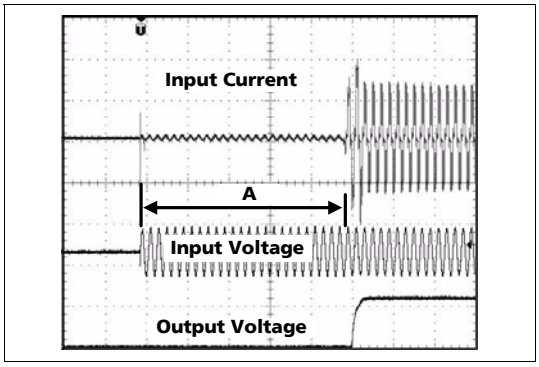
7. INPUT INRUSH CURRENT

An active inrush limitation circuit limits the input inrush current after turn-on of the input voltage and after short input voltage interruptions. The inrush limitation is temperature independent.

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

		3AC 400V	**3AC 480V**	
Inrush current	max.	$6A_{peak}$	$6A_{peak}$	-25°C to +70°C
	typ.	$4.5A_{peak}$	$4.5A_{peak}$	-25°C to +70°C
Inrush energy	max.	$1.5A^2s$	$1.5A^2s$	-25°C to +70°C
Inrush delay	typ.	500ms	600ms	

Fig. 7-1 **Input inrush current, typical behavior**



A Inrush delay

Input: 3x400Vac
Output: 24V, 40A
Ambient: 25°C

Upper curve: Input current 2A / DIV
Medium curve: Input voltage 1000V / DIV
Lower curve: Output voltage 20V / DIV
Time basis: 100ms / DIV

8. OUTPUT

Output voltage	nom.	24V	
Adjustment range	min.	24-28V	guaranteed, multi turn potentiometer
	max.	30V	at clockwise end position of potentiometer
Factory setting		24.1V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	3x 323-576Vac
Load regulation	max.	50mV	in "single use" mode: static value, 0A → 40A see Fig. 8-1
	typ.	1000mV	in "parallel use" mode: static value, 0A → 40A, see Fig. 8-2
Ripple and noise voltage	max.	100mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	8 600µF	

Continuous output current and output power

Output current	nom.	40A	at 24V, see Fig. 8-1
	nom.	34.3A	at 28V, see Fig. 8-1
Output power	nom.	960W	
Short-circuit current	min.	40A	load impedance 25mOhm, see Fig. 8-1
	max.	44A	load impedance 25mOhm, see Fig. 8-1

Short term output current and output (BonusPower®)

The power supply is designed to support loads with a higher short-term power requirement without damage or shutdown. The short-term duration is hardware controlled by an output power manager. The BonusPower® is available on a repeated basis. Detailed information can be found in chapter 28.1 .

Once BonusPower® has been suspended by the output power limiter, a timer disables the next BonusPower® capability. The recovery timer will start as soon as the output voltage reaches the adjusted value again, which usually happens after the load has been reduced.

Output current	nom.	60A	at 24V, see Fig. 8-1
	nom.	51.5A	at 28V, see Fig. 8-1
Output power	nom.	1440W	BonusPower®
Short-circuit current	min.	60A	load impedance 25mOhm, see Fig. 8-1
	max.	68A	load impedance 25mOhm, see Fig. 8-1
BonusPower® time	typ.	4s	at 24V, 60A, duration until the output voltage dips,
	min	3.5s	see Fig. 8-3
	max.	4.5s	
BonusPower® recovery time	typ.	7s	overload free time to reset power manager, see Fig. 8-4

Peak output current capability (up to several ms)

The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 28.2.

Peak current voltage dips	typ.	from 24V to 19V	at 80A for 20ms, resistive load
	typ.	from 24V to 12V	at 200A for 2ms, resistive load
	typ.	from 24V to 10V	at 200A for 5ms, resistive load

Fig. 8-1 **Typical output voltage vs. output current in "single-use" mode**

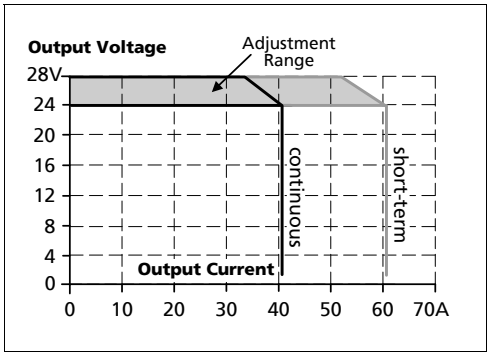


Fig. 8-2 **Typical output voltage vs. Output current in "parallel-use" mode**

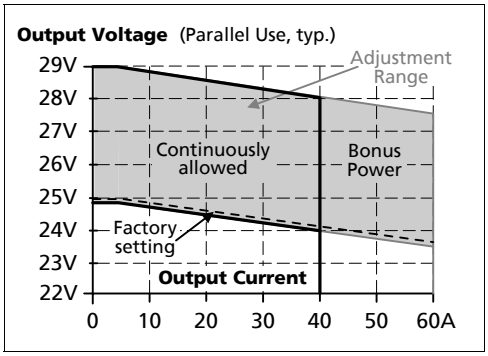


Fig. 8-3 **Bonus time vs. output power**

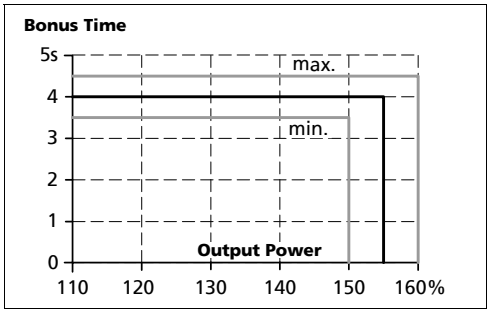
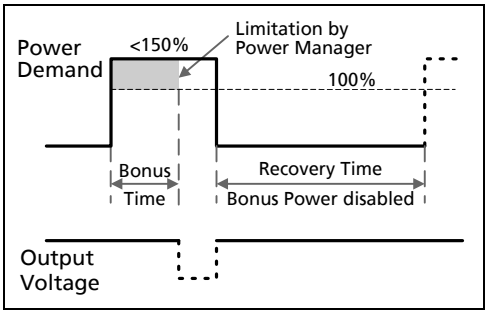
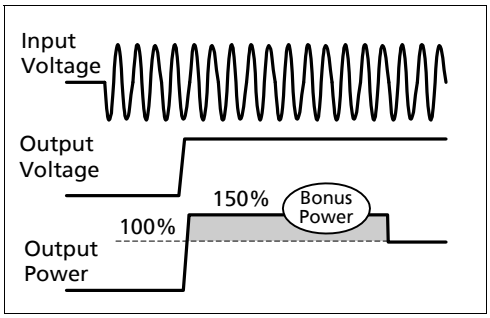


Fig. 8-4 **BonusPower® recovery time**



The BonusPower® is available as soon as power comes on

Fig. 8-5 **BonusPower® after input turn-on**



9. HOLD-UP TIME

		3AC 400V	3AC 480V	
Hold-up Time	typ.	25ms	25ms	at 24V, 40A see **Fig. 9-1**
	typ.	50ms	50ms	at 24V, 20A, see **Fig. 9-1**

Hold-up time for an operation on only two legs of a three phase system differ, curves can be found in chapter 28.7

Fig. 9-1 **Hold-up time vs. input voltage**

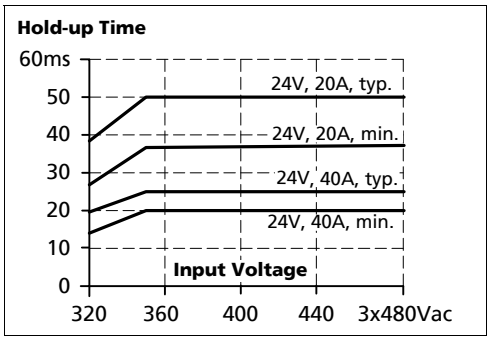
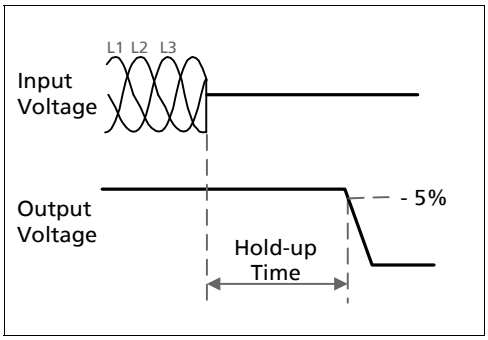


Fig. 9-2 **Shut-down behavior, definitions**

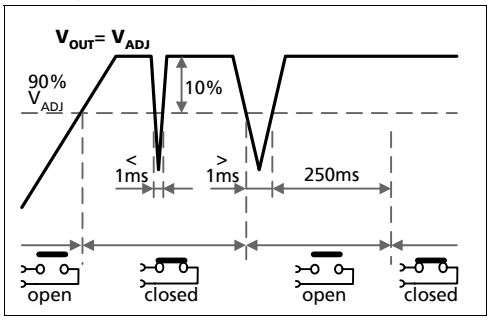


10. DC-OK RELAY CONTACT

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.

Contact closes	As soon as the output voltage reaches 90% of the adjusted output voltage.		
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 250ms. Dips shorter than 1ms will be ignored.		
Contact re-closes	As soon as the output voltage exceeds 90% of the adjusted voltage.		
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 21		

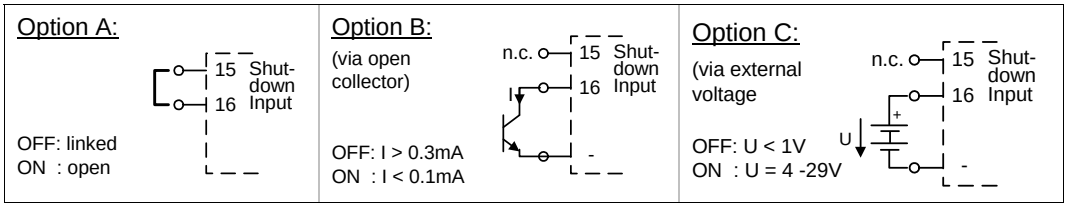
Fig. 10-1 **DC-ok relay contact behavior**



11. SHUT-DOWN INPUT

This feature allows to switch-off the output of the power supply with a signal switch or an external voltage. The shut-down function ramps down and has no safety feature included. The shut-down occurs immediately while the turn-on is delayed by 350ms. In a shut-down condition, the output voltage is <2V and the output power is <0.5W. The voltage between different –pole output terminals must be below 1V when units are connected in parallel. In a series operation of multiple power supplies only wiring option "A" with individual signal switches is allowed.

Fig. 11-1 **Activation of the shut-down input**



12. EFFICIENCY AND POWER LOSSES

		3AC 400V	3AC 480V	
Efficiency	typ.	95.3%	95.2%	at 24V, 40A and 3-phase operation
	typ.	94,4%	94.7%	at 24V, 40A, when using only 2 legs of a 3-phase system, curves can be found in chapter 28.7
Average efficiency *)	typ.	94.7%	94.6%	25% at 10A, 25% at 20A, 25% at 30A. 25% at 40A, 3-Phase operation
Power losses	typ.	9.5W	9.8W	at 24V, 0A
	typ.	47.3W	48.4W	at 24V, 40A and 3-phase operation
	typ.	56.9W	53.7W	at 24V, 40A, when using only 2 legs of a 3-phase system, curves can be found in chapter 28.7

*) 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. 12-1 **Efficiency vs. output current at 24V, 3-phase operation**

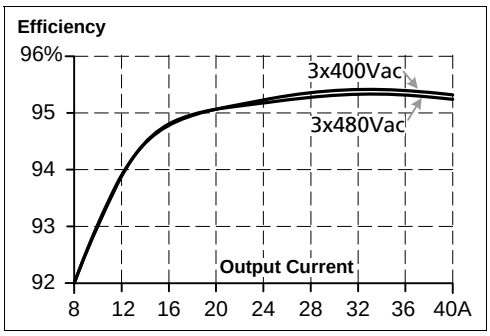


Fig. 12-2 **Losses vs. output current at 24V, 3-phase operation**

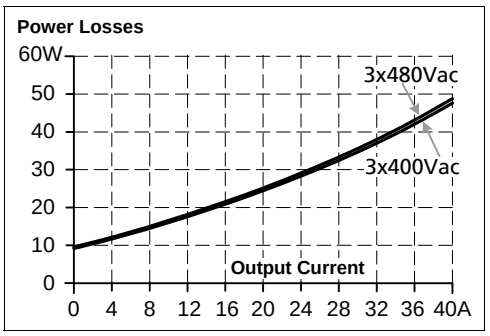


Fig. 12-3 **Efficiency vs. input voltage, 24V, 40A, 3-phase operation**

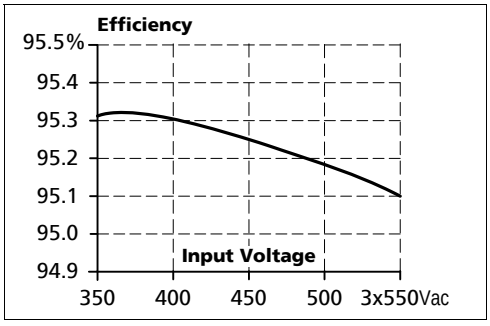
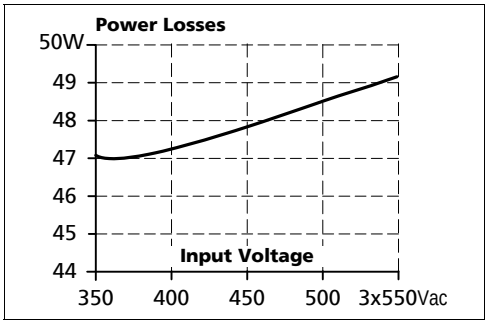
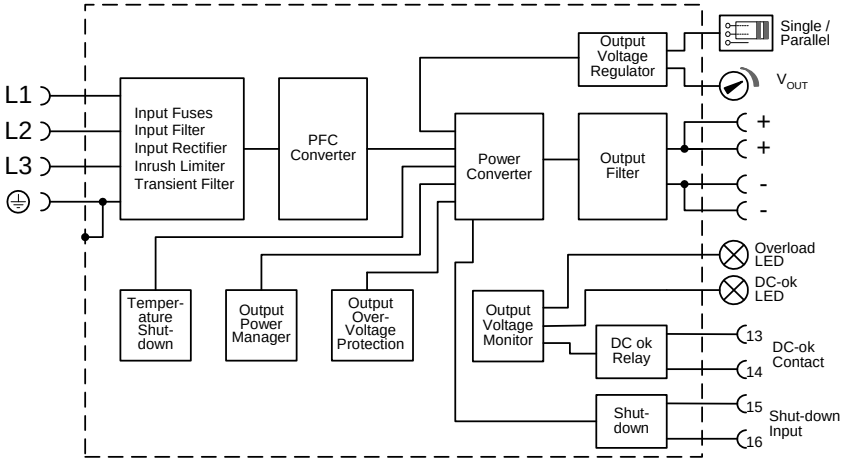


Fig. 12-4 **Losses vs. input voltage, 24V, 40A, 3-phase operation**



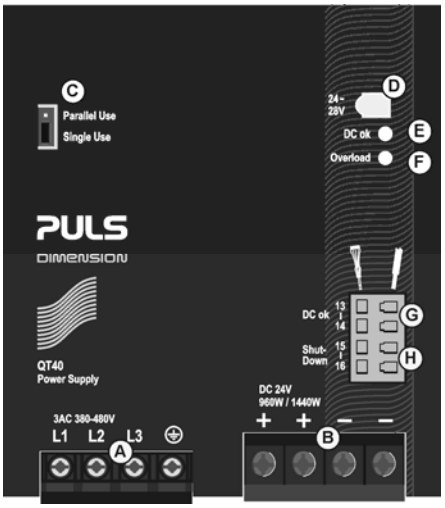
13. FUNCTIONAL DIAGRAM

Fig. 13-1 **Functional diagram**



14. FRONT SIDE, USER ELEMENTS AND SIGNALING

Fig. 14-1 **Front side**



A Input Terminals
Screw terminals
L1, L2, L3 Line input
⏚...PE (Protective Earth) input

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

C "Parallel Use" "Single Use" selector
Set jumper to "Parallel Use" when power supplies are connected in parallel to increase the output power. In order to achieve a sharing of the load current between the individual power supplies, the "parallel use" regulates the output voltage in such a manner that the voltage at no load is approx. 5% higher than at nominal load. See also 28.8.
A missing jumper is equal to a "Single Use" mode.

D Output voltage potentiometer
Open the flap to set the output voltage. Factory set: 24.1V

E DC-OK LED (green)
On, when the voltage on the output terminals is >90% of the adjusted output voltage

F Overload LED (red)
- On, when the voltage on the output terminals is <90% of the adjusted output voltage, or in case of a short circuit in the output. Input voltage is required
- Flashing, when the shut-down has been activated or the unit has switched off due to over-temperature.

G DC-OK Relay Contact
The DC-OK relay contact is synchronized with the DC-OK LED. See chapter 10 for details.

H Shut-down Input
Allows the power supply to be shut down. Can be activated with a dry relay contact or an external voltage.
See chapter 11 for details.

15. TERMINALS AND WIRING

	Input	Output	DC-OK, Shut-down
Type	screw termination	screw termination	spring-clamp termination
Solid wire	0.5-6mm²	0.5-16mm²	0.15-1.5mm²
Stranded wire	0.5-4mm²	0.5-10mm²	0.15-1.5mm²
American Wire Gauge	20-10 AWG	22-8 AWG	26-14 AWG
Wire stripping length	7mm / 0.28inch	12mm / 0.5inch	7mm / 0.28inch
Recommended tightening torque	0.8Nm, 7lb.in	1.2Nm, 10.6lb.in	not applicable

Instructions:

a) Use appropriate copper cables that are designed for an operating temperature of:
60°C for ambient up to 45°C and 75°C for ambient up to 60°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
e) Do not use the unit without PE connection.
f) Screws of unused terminal compartments should be securely tightened.
g) Ferrules are allowed, but not required

16. RELIABILITY

3-Phase operation		3AC 400V	3AC 480V	
Lifetime expectancy *)	min.	T.B.D.	T.B.D.	at 24V, 40A and 40°C
	min.	T.B.D.	T.B.D.	at 24V, 20A and 40°C
	min.	T.B.D.	T.B.D.	at 24V, 40A and 25°C
MTBF **) SN 29500, IEC 61709		375 000h	369 000h	at 24V, 40A and 40°C
		685 000h	678 000h	at 24V, 40A and 25°C
MTBF **) MIL HDBK 217F		158 000h	157 000h	at 24V, 40A and 40°C; Ground Benign GB40
		211 000h	210 000h	at 24V, 40A and 25°C; Ground Benign GB25

Operation only on 2 legs of a 3-Phase System		2AC 400V	2AC 480V	
Lifetime expectancy *)	min.	T.B.D.	T.B.D.	at 24V, 40A and 40°C
	min.	T.B.D.	T.B.D.	at 24V, 20A and 40°C
	min.	T.B.D.	T.B.D.	at 24V, 40A and 25°C
MTBF **) SN 29500, IEC 61709		T.B.D.	T.B.D.	at 24V, 40A and 40°C
		T.B.D.	T.B.D.	at 24V, 40A and 25°C
MTBF **) MIL HDBK 217F		T.B.D.	T.B.D.	at 24V, 40A and 40°C; Ground Benign GB40
		T.B.D.	T.B.D.	at 24V, 40A and 25°C; Ground Benign GB25

*) The **Lifetime expectancy** shown in the table indicates the 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 prediction model allows a calculation of up to 15 years from date of shipment.

) **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 life of a product.

17. EMC

The power supply is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions. The CE mark indicates conformance with EMC guideline 89/336/EEC, 93/68/EEC and 2004/108/EC and the low-voltage directive (LVD) 73/23/EWG and 2006/95/EC. A detailed EMC report is available on request.

EMC Immunity	EN 61000-6-1 EN 61000-6-2		Generic standards	
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 15kV	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	4kV 2kV	Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L1 → L2, L2 → L3, L1 → L3	2kV	Criterion A
Surge voltage on input	EN 61000-4-5	L1 / L2 / L3 → PE	4kV	Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	500V 500V	Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	10V	Criterion A
Mains voltage dips (Dips on three phases)	EN 61000-4-11	0% of 380Vac 0% of 480Vac	0Vac, 20ms 0Vac, 20ms	Criterion A Criterion A
Mains voltage dips (Dips on two phases)	EN 61000-4-11	40% of 380Vac 40% of 480Vac 70% of 380Vac 70% of 480Vac	200ms 200ms 500ms 500ms	Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11		0Vac, 5000ms	Criterion C
Voltage sags	SEMI F47	Dips on two legs according to section 7.2. of the SEMI F47 standard		
		80% of 380Vac 70% of 380Vac 50% of 380Vac	1000ms 500ms 200ms	Criterion A Criterion A Criterion A
Powerful transients	VDE 0160	over entire load range	1550V, 1.3ms	Criterion A

Criterions:
A: Power supply shows normal operation behavior within the defined limits.
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	EN 61000-6-3 and EN 61000-6-4	Generic standards
Conducted emission	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B, input lines
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	fulfilled
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.

Switching Frequencies	The power supply has three converters with three different switching frequencies included. One is nearly constant. The other two are input voltage and load dependent.	
Switching frequency 1	110kHz	nearly constant
Switching frequency 2	30kHz 90kHz	input voltage and load dependent
Switching frequency 3	40kHz to 220kHz	input voltage and load dependent

18. ENVIRONMENT

Operational temperature	-25°C to +70°C (-13°F to 158°F)	reduce output power according **Fig. 18-1**
Output de-rating	24W/°C	60-70°C (140°F to 158°F)
Storage temperature	-40 to +85°C (-40°F to 185°F)	for storage and transportation
Humidity *)	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal	2-17.8Hz: ±0.8mm; 17.8-500Hz: 1g 2 hours / axis	IEC 60068-2-6
Shock	15g 6ms, 10g 11ms 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 6000m (0 to 20 000ft)	reduce output power or ambient temperature above 2000m sea level according to **Fig. 18-1**
Output de-rating (for altitude)	15W/1000m or 5°C/1000m	above 2000m (6500ft), see **Fig. 18-2**
Over-voltage category	III	IEC 62103, EN 50178, for altitudes up to 2000m
	II	altitudes from 2000m to 6000m
Degree of pollution	2	IEC 62103, EN 50178, not conductive

*) Do not energize while condensation is present

Fig. 18-1 **Output current vs. ambient temp.**

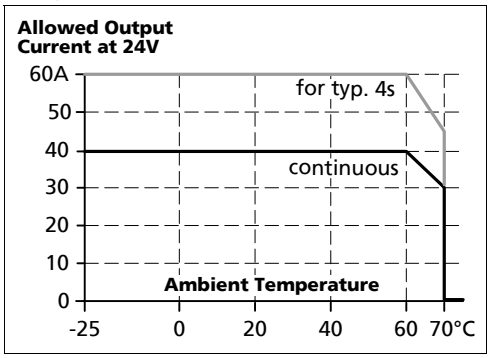
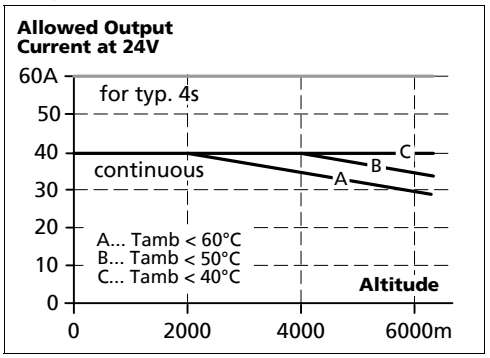


Fig. 18-2 **Output current vs. altitude at 24V**



The ambient temperature is defined as the air temperature 2cm below the unit.

19. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits	
Output over-voltage protection	typ. 30Vdc max. 32Vdc	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
Penetration protection	> 5mm	e.g. screws, small parts
Over-temperature protection	yes	Output shut-down with automatic restart
Input transient protection	MOV (Metal Oxide Varistor) and active transient filter	
Internal input fuse	3x T6.3A H.B.C.	not user replaceable

Note: In case of a protection event, audible noise may occur.

20. SAFETY

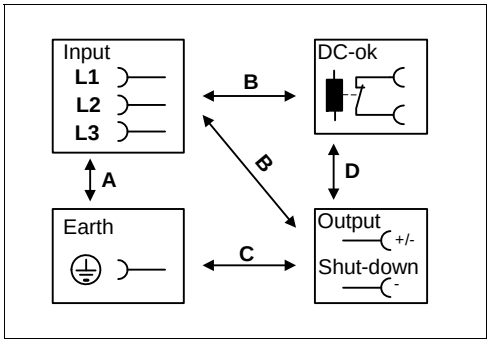
Input / output separation *)	SELV	IEC/EN 60950-1
	PELV	EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 5MOhm	Input to output, 500Vdc
PE resistance	< 0.1Ohm	Between housing and PE terminal
Touch current (leakage current)	typ. 0.35mA	3x 400Vac, 50Hz, TN mains
	typ. 0.45mA	3x 480Vac, 60Hz, TN mains
	< 0.45mA	3x 440Vac, 50Hz, TN mains
	< 0.60mA	3x 528Vac, 60Hz, TN mains

*) Double or reinforced insulation

21. 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 phase-terminals together as well as all output poles before conducting the test.

Fig. 21-1 **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

To fulfill 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.

22. APPROVALS

IEC 60950-1	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 508	c UL US LISTED IND. CONT. EQ.	LISTED E198865 listed for use in U.S.A. (UL 508) and Canada (C22.2 No. 14-95) Industrial Control Equipment
UL 60950-1	c UL us	RECOGNIZED E137006 recognized for the use in U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950) Information Technology Equipment, Level 5
Class I Div 2 pending	c UL us	RECOGNIZED E246877 Hazardous Location Class I Div 2 T4 Groups A,B,C and D ANSI/ISA-12.12.01 (UL 1604)
	The unit is suitable for use in Class I Division 2 Groups A, B, C, D locations. Substitution of components may impair suitability for Class I Division 2 environment. Do not disconnect equipment unless power has been switched off. Wiring must be in accordance with Class I, Division 2 wiring methods of the National Electrical Code, NFPA 70, and in accordance with other local or national codes.	
Marine, pending	GL ABS	GL (Germanischer Lloyd) classified and ABS (American Bureau for Shipping) PDA for marine and offshore applications. Environmental category: C, EMC2
SEMI F47, pending	SEMI F47	SEMI F47 Power Quality Star Ride-through compliance for semiconductor industry. Full SEMI range compliance (Dips on two phase: 304Vac for 1000ms, 266Vac for 500ms and 190Vac for 200ms), Pout < 960W

23. FULFILLED STANDARDS

EN 61558-2-17	Safety of Power Transformers
EN/IEC 60204-1	Safety of Electrical Equipment of Machines
EN/IEC 61131-2	Programmable Controllers
EN 50178, IEC 62103	Electronic Equipment in Power Installations

24. USED SUBSTANCES

The unit does not release any silicone and is suitable for the use in paint shops.

The unit conforms to the RoHS directive 2002/96/EC

Electrolytic capacitors included in this unit do not use electrolytes such as Quaternary Ammonium Salt Systems.

Plastic housings and other molded plastic materials are free of halogens, wires and cables are not PVC insulated.

The production material within our production does not include following toxic chemicals:
Polychlorized Biphenyl (PCB), Polychlorized Terphenyl (PCT), Pentachlorophenol (PCP), Polychlorinated naphthalene (PCN), Polybrom Biphenyll (PBB), Polybrom Bipheny-oxyd (PBO), Polybrominated Diphenylether (PBDE), Polychlorinated Diphenylether (PCDE), Polydibromphenyl Oxyd (PBDO), Cadmium, Asbest, Mercury, Silicia

25. PHYSICAL DIMENSIONS AND WEIGHT

Weight	1500g / 3.31lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN-rail height must be added to the depth (127mm) to calculate the total required installation depth.

Electronic files with mechanical data can be downloaded at www.pulspower.com

Fig. 25-1 **Front view**

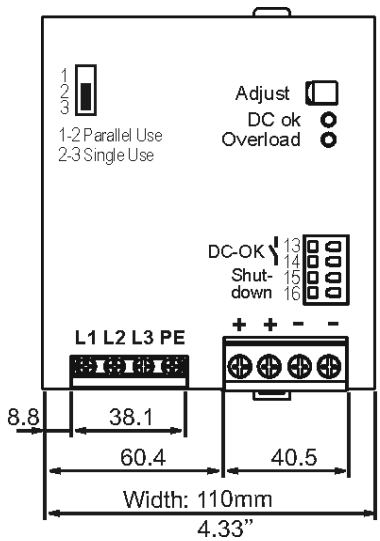
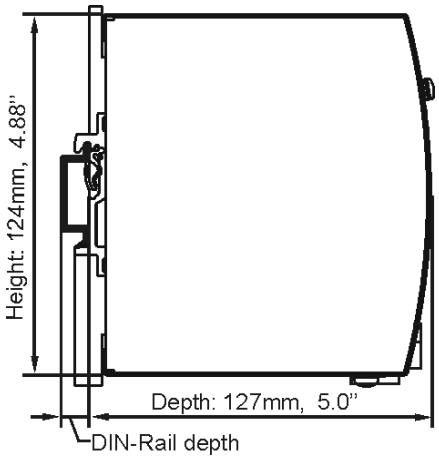


Fig. 25-2 **Side view**



26. INSTALLATION AND OPERATION INSTRUCTIONS

Mounting Orientation:
Output and input terminals must be located on the bottom of the unit. For other orientations see chapter 28.14.

Cooling:
Convection cooled, no forced cooling required. Do not cover ventilation grid (e.g. cable conduit) by more than 30%!

Installation clearances:
40mm on top, 20mm on the bottom, 5mm on the left and right side are recommended when loaded permanently with full power. In case the adjacent device is a heat source, 15mm clearance are recommended.

Risk of electrical shock, fire, personal injury or death!
Do not use the unit without proper earth connection (Protective Earth). Use the terminal on the input block for earth connection and not one of the screws on the housing.
Turn power off before working on the power supply. Protect against inadvertent re-powering.
Make sure the wiring is correct by following all local and national codes.
Do not open, modify or repair the unit.
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.

Service parts:
The unit does not contain any service parts. The tripping of an internal fuse is caused by an internal defect. If damage or malfunctioning should occur during operation, immediately turn power off and send unit to factory for inspection!

27. ACCESSORIES

ZM2.WALL Wall mounting bracket

This bracket is used to mount specific Dimension units onto a flat surface without utilizing a DIN-Rail. The two aluminum brackets and the black plastic slide of the unit have to be removed, so that the two steel brackets can be mounted.

Fig. 27-1 **ZM1.WALL Wall Mounting Bracket**

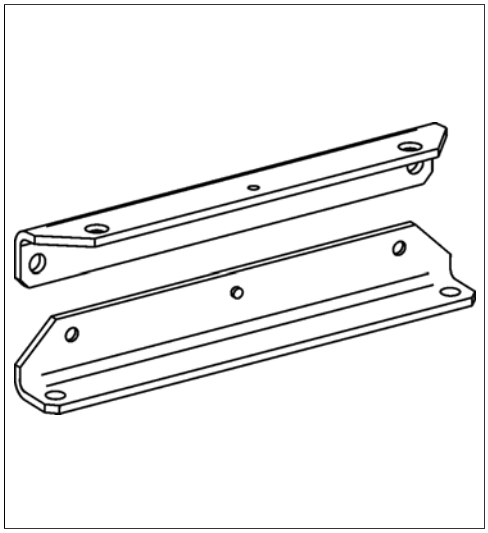
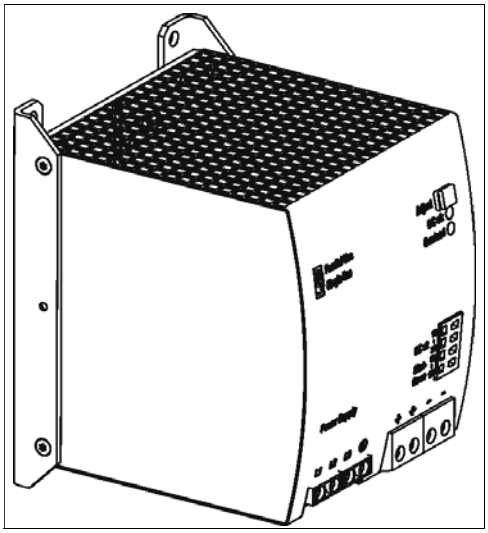


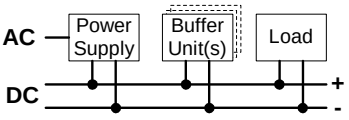
Fig. 27-2 **Assembled Wall Mounting Bracket**



Buffer module UF20.241

This buffer unit is a supplementary device for DC24V power supplies. It delivers power to bridge typical mains failures or extends the hold-up time after turn-off of the AC power. In times when the power supply provides sufficient voltages, the buffer unit stores energy in integrated electrolytic capacitors. In case of mains voltage fault, this energy is released again in a regulated process. One buffer module can deliver 20A. To buffer the full output current of 40A, two buffer modules are needed in parallel.

The buffer unit does not require any control wiring. It can be added in parallel to the load circuit at any given point. Buffer units can be added in parallel to increase the output ampacity or the hold-up time.



28. APPLICATION NOTES

28.1. REPETITIVE PULSE LOADING

Typically, a load current is not constant. It varies over time. For pulse load compatibility, the following rules must be met:

a) The pulse power demand must be below 150% of the nominal power.
b) The duration of the pulse power must be shorter than the allowed Bonus Time. (see output section)
c) The average (R.M.S.) output current must be below the specified continuous output current.
If the R.M.S. current is higher, the unit will respond with a thermal shut-down after a period of time. Use the maximum duty cycle curve (Fig. 28-2) to check if the average output current is below the nominal current.
d) The duty cycle must be below 0.75.
e) For altitudes higher than 2000m reduce the pulse loading (15W/1000m) or the ambient temperature (5°C/1000m)

Fig. 28-1 **Repetitive pulse loads, definitions**

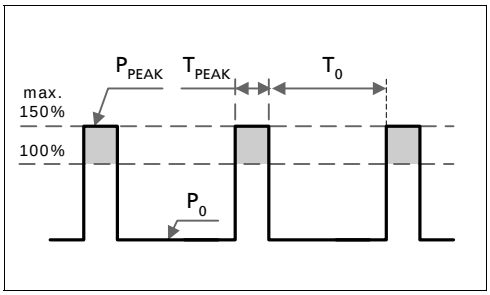
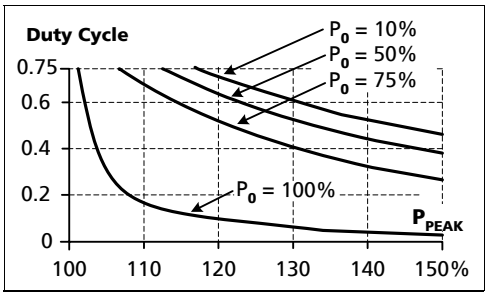


Fig. 28-2 Max. Duty Cycle Curve



P_0 Base load (W)
P_{PEAK} Pulse load (above 100%)
T_0 Duration between pulses (s)
T_{PEAK} Pulse duration (s)

$$DutyCycle = \frac{T_{peak}}{T_{peak} + T_0}$$

$$T_0 = \frac{T_{peak} - (DutyCycle \times T_{peak})}{DutyCycle}$$

Utilizing the maximum duty cycle curve:

Example to determine the repetition rate of pulses without dipping of the output voltage:

Parameters of application:

Pulse length is T_{PEAK} = 1s

Steady state load P_0=480W (= 50% of I_{RATED})

Peak load P_{PEAK} = 1440W (= 150% of I_{RATED})

Determining the repetition rate:

1) make a vertical line at P_{PEAK} = 150%
2) make a horizontal line where the vertical line crosses the P_0 = 50% curve
3) Read the Max. Duty Cycle from the Duty Cycle-axis (= 0.37)
4) Calculate the minimum pause (base load) length T_0 :

$$T_0 = \frac{T_{peak} - (DutyCycle \times T_{peak})}{DutyCycle} = \frac{1s - (0.37 \times 1s)}{0.37} = \underline{\mathbf{1.7s}}$$

5) Pulse length = 1s, min. pause length = 1.7s
6) Max. repetition rate = pulse length +pause length = **2.7s**

More examples for pulse load compatibility:

P_{PEAK}	P_0	T_{PEAK}	T_0
1440W	960W	1s	>25s
1440W	0W	1s	>1.3s
1200W	480W	1s	> 0.75s

P_{PEAK}	P_0	T_{PEAK}	T_0
1440W	480W	0.1s	>0.16s
1440W	480W	1s	>1.6s
1440W	480W	3s	>4.9s

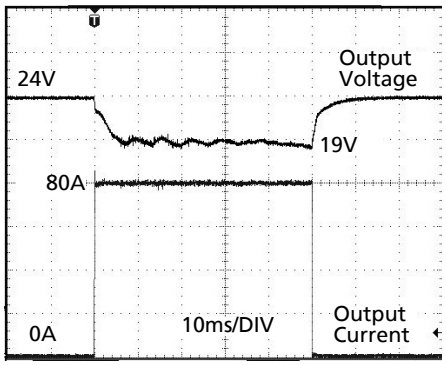
28.2. PEAK CURRENT CAPABILITY

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 (including the BonusPower®). The same situation applies, when starting a capacitive load.

Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in the branch circuit, the protection device needs a certain amount of over-current to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers. See also chapter 28.6.

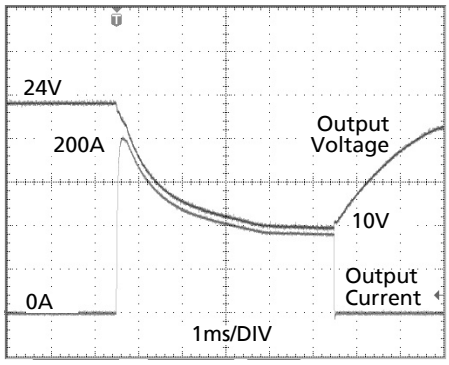
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 28-3 **Peak load 80A for 50ms, typ.**



Peak load 80A (resistive) for 50ms
Output voltage dips from 24V to 19V.

Fig. 28-4 **Peak load 200A for 5ms, typ.**



Peak load 200A (resistive) for 5ms
Output voltage dips from 24V to 10V.

28.3. 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 8.

28.4. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 30A (U.S.A.) and 32A (IEC). External protection is only required, if the supplying branch has an ampacity greater than this. In some countries local regulations might apply. Check also local codes and local requirements.

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 6A B- or 6A C-Characteristic breaker should be used.

28.5. CHARGING OF BATTERIES

The power supply can be used to charge lead-acid or maintenance free batteries. (Two 12V batteries in series)

Instructions for charging batteries:

a) Set jumper on the front of the unit into "Parallel use"

b) Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage.

End-of-charge voltage	27.8V	27.5V	27.15V	26.8V
Battery temperature	10°C	20°C	30°C	40°C

c) Use a 50A circuit breaker (or blocking diode) between the power supply and the battery.

d) Ensure that the output current of the power supply is below the allowed charging current of the battery.

e) Use only matched batteries when putting 12V types in series.

f) The return current to the power supply (battery discharge current) is typ. 35mA when the power supply is switched off (except when a blocking diode is utilized).

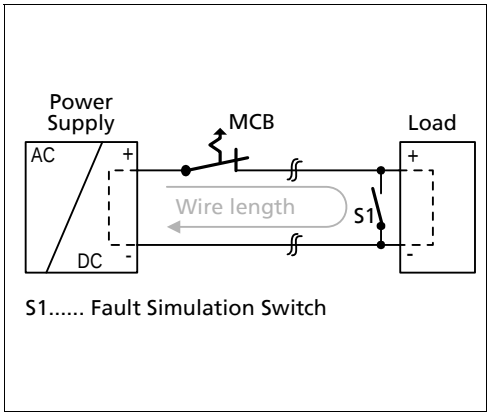
28.6. OUTPUT CIRCUIT BREAKERS

Standard miniature circuit breakers (MCB's or UL1077 circuit breakers) are without doubt, one of the most efficient and economical ways to open circuits on faulty branches. Most of these breakers may also be used on 24V branches.

MCB's are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

Fig. 28-5 **Test circuit**



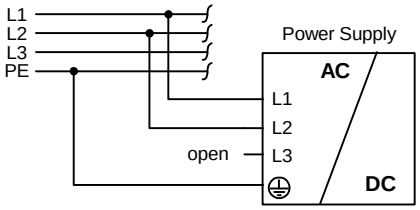
S1..... Fault Simulation Switch

Maximal wire length for a magnetic (fast) tripping:

	0.75mm²	1mm²	1.5mm²	2.5mm²
C-2A	24m	34m	48m	74m
C-3A	18m	31m	46m	72m
C-4A	17m	23m	31m	53m
C-6A	11m	16m	21m	37m
C-8A	7m	10m	14m	21m
C-10A	4m	6m	8m	11m
B-6A	22m	24m	46m	73m
B-10A	11m	14m	21m	30m
B-13A	9m	11m	16m	24m
B-16A	5m	6m	8m	13m
B-20A	1m	2m	4m	5m

Please note: Don't forget to consider two times the distance to the load (or cable length) when calculating the total wire length (+ and – wire).

28.7. USING ONLY 2 LEGS OF A 3-PHASE SYSTEM



No external protection device is required to protect against a phase-loss failure. The power supply is allowed to run permanently on two legs of a 3-Phase system, when the output power is reduced according to the curve below. A long-term exceeding of these limits will result in a thermal shut-down of the unit. Use of two legs on a 3-Phase system below 340Vac with more than 30A output current can result in a thermal shut-down. During power-on, some start-up attempts can occur until a permanent output power is available. EMC performance, hold-up time, losses and output ripple differ from a three phase operation. Therefore, check suitability of your individual application. Such use is not included in the UL approval. Additional tests might be necessary when the complete system has to be approved according to UL 508 or UL60950-1. The screw of the terminal which remains unused must be securely tightened. Using only two phases of a 3-phase system is not included in the UL approval. Additional testing might be necessary.

Fig. 28-6 **Allowed output current**

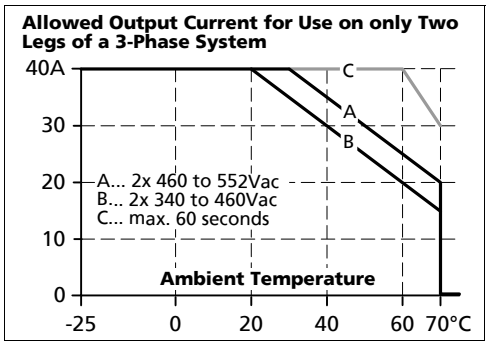


Fig. 28-7 **Hold-up time**

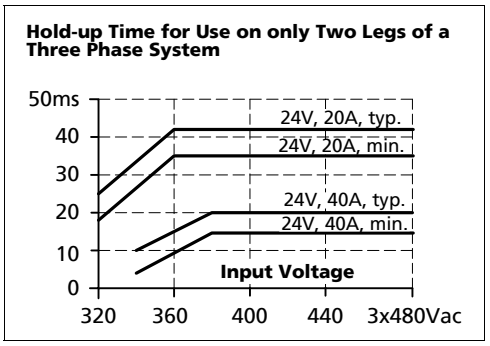


Fig. 28-8 **Efficiency vs. output current at 24V**

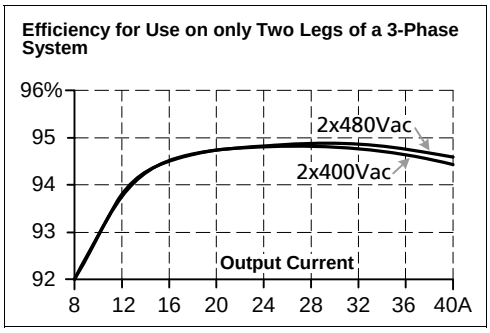
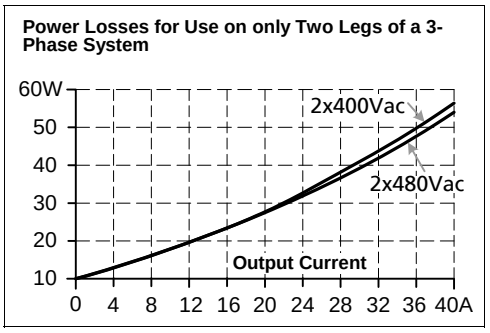
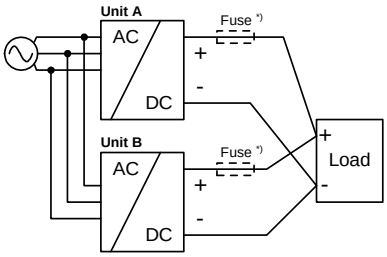


Fig. 28-9 **Losses vs. output current at 24V**



28.8. PARALLEL USE TO INCREASE OUTPUT POWER



Power supplies from the same series (Q-Series) can be paralleled to increase the output power. This use is only allowed in the standard mounting orientation (input and output terminals on bottom of the unit). The output voltage shall be adjusted to the same value (±100mV) in "Single use" mode with the same load conditions on all units, or the units can be left with the factory settings. After the adjustments, the jumper on the front of the unit shall be moved from "Single use" to "Parallel use", in order to achieve load sharing. The "Parallel use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 5% higher than at nominal load. If no jumper is plugged in, the unit is in "Single use". Factory setting is "Single use" mode. A fuse (or diode) on the output of each unit is only required if more than three units are connected in parallel. 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.

28.9. PARALLEL USE FOR REDUNDANCY

Power supplies can be paralleled for redundancy to gain higher system reliability. 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 1+1 redundancy. In case one power supply unit fails, the other one is automatically able to support the load current without any interruption. Redundant systems for a higher power demand are usually built in a N+1 method. E.g. five power supplies, each rated for 40A are paralleled to build a 160A redundant system.

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 case, the defect unit becomes a load for the other power supplies and the output voltage can not be maintained. This can be avoided by utilizing decoupling diodes which are included in the redundancy module SLR01.

Recommendations for building redundant power systems:

a) Use separate input fuses for each power supply.
b) Set the power supply into "Parallel Use".
c) Monitor the individual power supply units. Therefore, use the DC-OK relay contact of the unit.
d) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.

28.10. DAISY CHAINING OF OUTPUTS

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 54A. If the current is higher, use a separate distribution terminal block.

Fig. 28-10 **Daisy chaining of outputs**

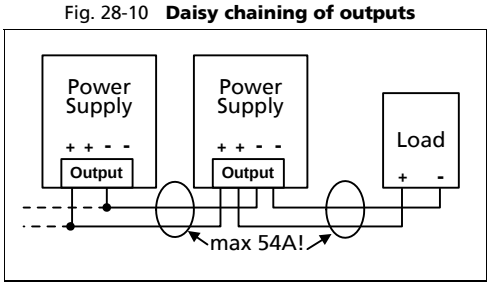
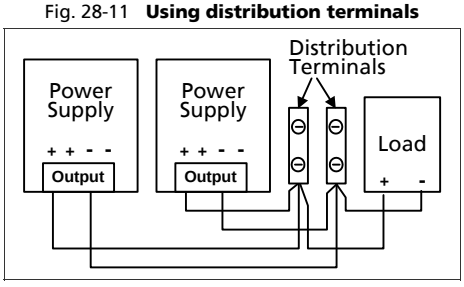


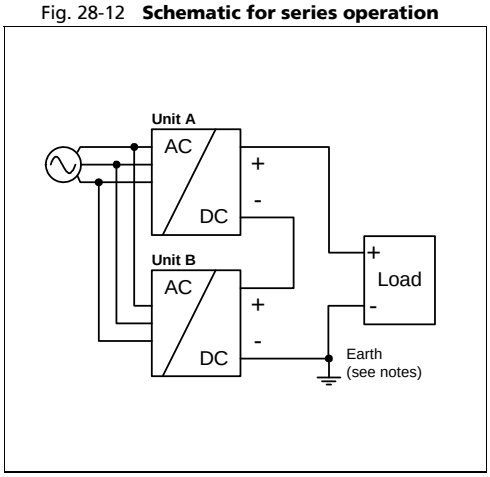
Fig. 28-11 **Using distribution terminals**



28.11. SERIES OPERATION

Power supplies can be connected in series for higher output voltages.

Fig. 28-12 **Schematic for series operation**



Instructions for series connection:

a) It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc.
b) Voltages with a potential above 60Vdc are not SELV and can be dangerous. Such voltages must be installed with a protection against touching.
c) For series operation use power supplies of the same type.
d) Earthing of the output is required when the sum of the output voltage is above 60Vdc.
e) Keep an installation clearance of 15mm (left/right) between two power supplies and avoid installing the power supplies on top of each other.

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

28.12. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

28.13. 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. The inside temperature defines the ambient temperature for the power supply.

Results from such an installation:

Power supply is placed in the middle of the box, no other heat producing items inside the box

Enclosure:	Rittal: Type IP66 Box PK 9522 100, plastic, 250x180x165mm
Load:	24V, 32A; (=80%) load is placed outside the box
Input:	3x 400Vac
Temperature inside enclosure:	52.5°C (in the middle of the right side of the power supply with a distance of 2cm)
Temperature outside enclosure:	23.8°C
Temperature rise:	28.7K

28.14. MOUNTING ORIENTATIONS

Mounting orientations other than input- and output terminals on the bottom require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different de-rating curves for continuous operation can be found below:

Curve A1 Recommended output current.
Curve A2 Max allowed output current (results in approximately half the lifetime expectancy of A1).

Fig. 28-13
Mounting Orientation A
Standard Orientation

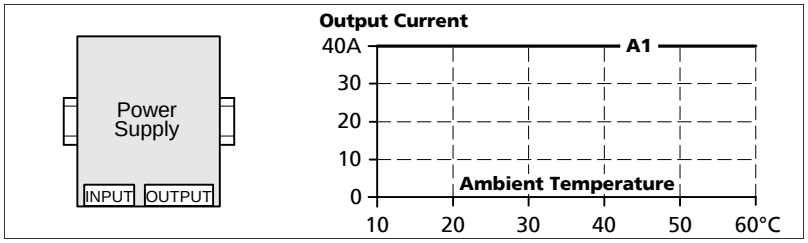


Fig. 28-14
Mounting Orientation B
(Upside down)

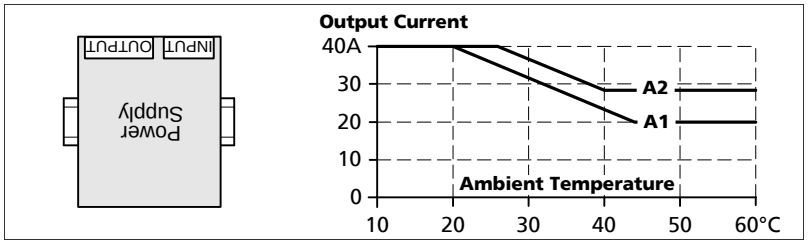


Fig. 28-15
Mounting Orientation C
(Table-top mounting)

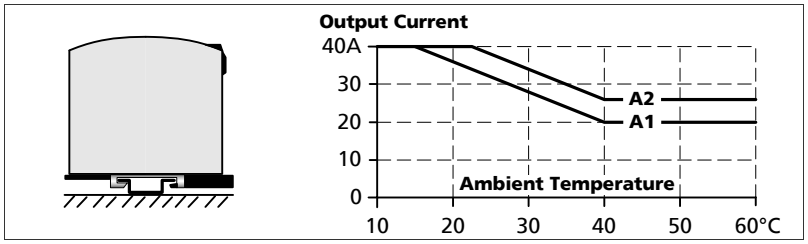


Fig. 28-16
Mounting Orientation D
(Horizontal cw)

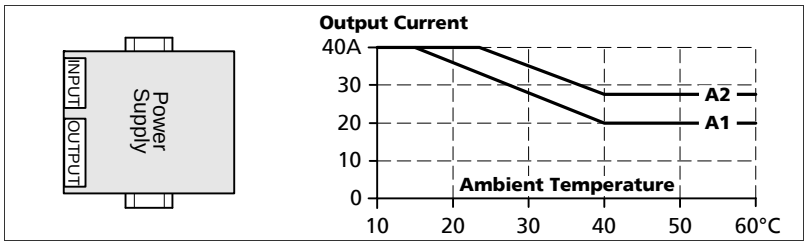


Fig. 28-17
Mounting Orientation E
(Horizontal ccw)