QTD20.241

24V, 20A, DC INPUT



DC/DC CONVERTER

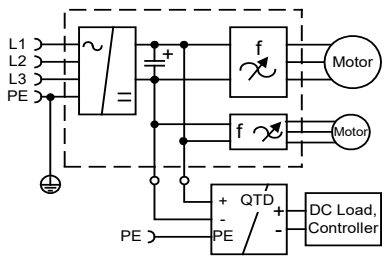
- DC 600V Input
- Optimized for Intermediate DC-bus of Drive Systems
- Two Input Fuses for DC 600V included
- 95% Full Load and Excellent Partial Load Efficiencies
- Width only 65mm, Weight only 890g
- 25% BonusPower, 600W for up to 4s
- Active Filtering of Input Transients
- Full Power Between -25°C and +60°C
- Extremely Low Input Inrush Current Surge
- Reverse Input Polarity Protection
- DC-OK Relay Contact
- Quick-connect Spring-clamp Terminals
- 3 Year Warranty

PRODUCT DESCRIPTION

Modern machines typically use maintenance-free AC-motors which are controlled by frequency converters or servo amplifiers. Such devices have an intermediate DC-bus where all individual drives are connected.

The QTD20 DC/DC converter can be connected directly to the intermediate DC-bus. In case of a mains failure, the QTD20 utilizes the power from the DC-bus capacitors which are charged from the kinetic energy of the motor until the motor has come to a complete stop.

The intermediate DC-bus is usually unfiltered and have high EMI noise so the QTD20 has a very robust input stage and an appropriate input filter included. Additionally, the QTD20 is UL 508 approved and is equipped with input fuses which are rated and tested for 600Vdc applications.



SHORT-FORM DATA

Output voltage	DC 24V	nominal
Adjustment range	24 - 28V	
Output current	20 – 17.5A	
	25 – 21.4A	short term (4s)
Output power	480W	
	600W	short term (4s)
Output ripple	< 100mVpp	20Hz to 20MHz
Input voltage	DC 600V	-20%/+40%
Input current	0.85A	at 600Vdc
Inrush current	typ. 1.6A_{peak}	
Efficiency	95.0%	at 600Vdc
Losses	25.5W	at 600Vdc
Temperature range	-25°C to +70°C	operational
Derating	12W/°C	+60 to +70°C
Hold-up time	typ. 22ms	at 600Vdc
Dimensions	65x124x127mm	WxHxD
Weight	890g	

ORDER NUMBERS

DC/DC converter	**QTD20.241**	
Accessory	ZM1.WALL	Wall mount bracket
	ZM14.SIDE	Side mount bracket
	UF20.241	Buffer unit
	YR40.241	Redundancy module

MAIN APPROVALS

For details and the complete approval list, see chapter 19.

c UL us LISTED

UL 508

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

INDEX

	Page
1. Intended Use	3
2. Installation Instructions	3
3. Input	5
4. Input Inrush Current	6
5. Output	7
6. Hold-up Time	9
7. DC-OK Relay Contact	9
8. Efficiency and Power Losses	10
9. Lifetime Expectancy	11
10. MTBF	11
11. Functional Diagram	12
12. Terminals and Wiring	13
13. Front Side and User Elements	14
14. EMC	15
15. Environment	16
16. Protection Features	17
17. Safety Features	17
18. Dielectric Strength	18
19. Approved, Fulfilled or Tested Standards	19
20. Regulatory Product Compliance	19
21. Physical Dimensions and Weight	20
22. Accessories	21
22.1. ZM1.WALL – Wall/Panel mounting	21
22.2. ZM14.SIDE - Side Mounting Bracket	21
22.3. UF20.241 - Buffer module	22
22.4. YR40.241 - Redundancy Module	22
23. Application Notes	23
23.1. Repetitive Pulse Loading	23
23.2. Peak Current Capability	24
23.3. External Input Protection	24
23.4. Charging of Batteries	25
23.5. Output Circuit Breakers	26
23.6. Series Operation	26
23.7. Parallel Use to Increase Output Power	27
23.8. Parallel Use for Redundancy	27
23.9. Inductive and Capacitive Loads	27
23.10. Back-feeding Loads	28
23.11. Use in a Tightly Sealed Enclosure	28
23.12. Mounting Orientations	29

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.

Some parts of this unit are patent by PULS (US patent No 091662,063, Des. 424,529, …).

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.
DC 600V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
600Vdc	A figure with the unit (Vac or Vdc) at the end is a momentary figure without any additional tolerances included.
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.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

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 and measurement equipment or the like.

This device is optimized to operate from the intermediate bus of a drive system. It can cope with the EMI disturbances on such busses.

Do not use this device in equipment, where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices, that are suited for the end-application.

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

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. Other mounting orientations require a reduction in output current.

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 +60°C and 90°C for ambient temperatures up to +70°C.

Ensure that all strands of a stranded wire enter the terminal connection. Use ferrules for wires on the input terminals.

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 devices is designed to withstand impulse voltages up to 4kV 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 designed to be supplied from a DC input voltage derived from a 3-phase mains network by means of a B6 bridge rectifier. The device is not designed to be used on corner grounded delta systems. Follow the wiring scheme option 1 shown in this document.

The input can also be supplied by batteries or similar DC sources. Since the continuous voltage between the input voltage and the PE/earth potential must not exceed 440V r.m.s., the input voltage must be grounded at about half the supply voltage as shown in option 2 in the wiring scheme drawing. Do not ground the positive or negative input voltage pole.

Check for correct input polarity. The device will not operate when the voltage is reversed.

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!

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

The device is designed for altitudes up to 5000m.

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 16A (IEC) and 15A (UL) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or 3A C-Characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +70°C. 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.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

3. INPUT

Input	nom.	DC 600V $^{-20\%/+40\%}$	
Input range		480-840Vdc	
		360-480Vdc	Max. 60s or with reduced output current, see Fig. 5-2
		840-900Vdc	Max. 60s or with reduced output current, see Fig. 5-2
	max.	1000Vdc	Absolute maximum input voltage with no damage to the DC/DC converter. Above 900Vdc, the output will switch off and will turn-on again, when the input voltage falls below 850Vdc.
Allowed voltage input to Earth	max.	440V r.m.s.	Continuous, IEC 60664-1
	max.	±900Vpk	Peak value, allowed for transients
Slew rate for voltages between input and Earth (ground)	max.	1000V/µs	
Allowed input ripple voltage	max.	50Vpp	50Hz-40kHz
Turn-on voltage	typ.	450Vdc	Steady-state value, load independent, see Fig. 3-1
Shut-down voltage	typ.	325Vdc	Steady-state value, load independent, see Fig. 3-1
Input current	typ.	0.79A	At 24V, 20A, see Fig. 3-3
Start-up delay	typ.	350ms	See Fig. 3-2
Rise time	typ.	70ms	At 24V, 20A, only resistive load see Fig. 3-2
	typ.	110ms	At 24V, 20A, resistive load with an additional 20mF capacitor
Turn-on overshoot	max.	500mV	See Fig. 3-2
External capacitors on input		Allowed without any limitations	

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

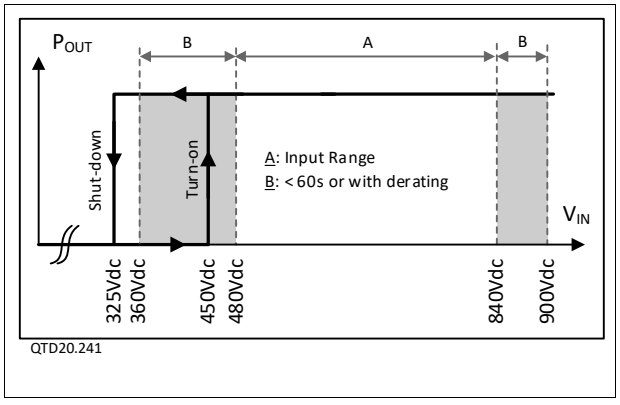


Fig. 3-2 **Turn-on behavior, definitions**

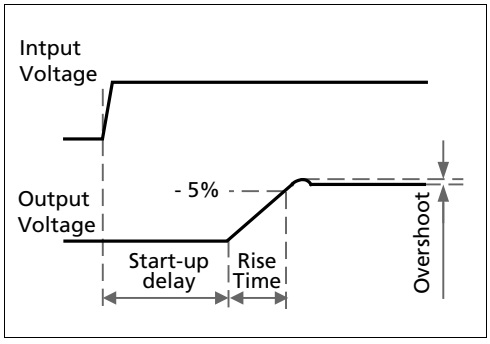
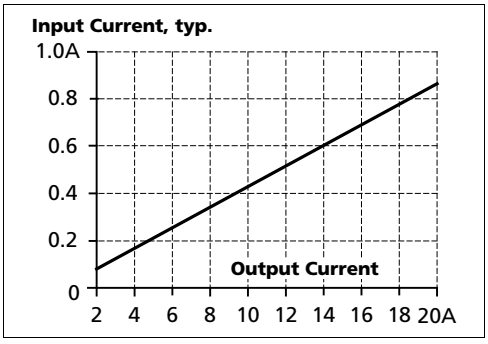


Fig. 3-3 **Input current vs. output load at 24V**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

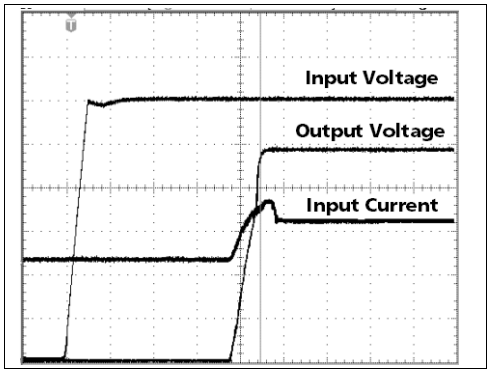
4. INPUT INRUSH CURRENT

The DC/DC converter is equipped with an active inrush current limitation circuit, which limits the input inrush current after turn-on and after short input voltage interruptions to a very low value.

		DC 600V	
Inrush current*)	max.	$3A_{peak}$	Over entire temperature range
	typ.	$1.6A_{peak}$	Over entire temperature range
Inrush energy	max.	$1A^2s$	Over entire temperature range
Inrush delay	typ.	350ms	

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

Fig. 4-1 **Typical turn-on behavior at nominal load and 25°C ambient temperature**



Input: 600Vdc
Output: 24V, 20A
Ambient: 25°C

Upper curve: Input voltage 100V/Div
Medium curve: Output voltage 5V/DIV
Lower curve: Input current 1A/DIV
Time base: 100ms/DIV

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

5. OUTPUT

Output voltage	nom.	24V	
Adjustment range		24-28V	Guaranteed
	max.	30V [3]	At clockwise end position of potentiometer
Factory setting	typ.	24.1V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	At 480-840Vdc voltage change
Load regulation	max.	100mV	Static value, 0A→20A
Ripple and noise voltage	max.	100mVpp	20Hz to 20MHz, 50Ohm
Output current – continuous	nom.	20A [4]	At 24V, input: 480-840Vdc, see Fig. 5-1
	nom.	17.5A [4]	At 28V, input: 480-840Vdc, see Fig. 5-1
Output current – up to 4s [1]	nom.	25A	At 24V, input: 480-840Vdc, see Fig. 5-1 and Fig. 5-3
	nom.	21.4A	At 28V, input: 480-840Vdc, see Fig. 5-1 and Fig. 5-3
Output power – continuous	nom.	480W	At 24-28V
Output power – up to 4s [1]	nom.	600W	At 24-28V
BonusPower time	typ.	4s	Duration until the output voltage dips, see Fig. 5-3
BonusPower recovery time	typ.	7s	Overload free time to reset power manager, see Fig. 5-4
Overload behavior		cont. current	See Fig. 5-1
Short-circuit current [2]	min.	20A	Continuous, load impedance 50mOhm, see Fig. 5-1
	max.	23A	Continuous, load impedance 50mOhm, see Fig. 5-1
	min.	25A	Short-term (4s), load impedance 50mOhm, see Fig. 5-1
	max.	28A	Short-term (4s), load impedance 50mOhm, see Fig. 5-1
Output capacitance	typ.	950µF	Included in the DC/DC converter

1) BonusPower, short term power capability (up to typ. 4s)
The DC/DC converter 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. This BonusPower is repeatedly available. Detailed information can be found in chapter 23.1. If the DC/DC converter is loaded longer with the BonusPower than shown in the bonus-time diagram (see Fig. 5-3), the max. output power is automatically reduced to 480W.

2) Discharge current of output capacitors is not included.

3) 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.

4) Reduce output current according to Fig. 5-2 for the extended input voltage ranges from 360-480Vdc and 840-900Vdc.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

Fig. 5-1 **Output voltage vs. output current, typ.**

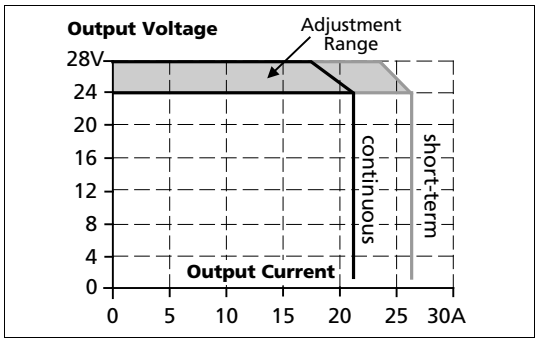


Fig. 5-2 **Output current vs. input voltage**

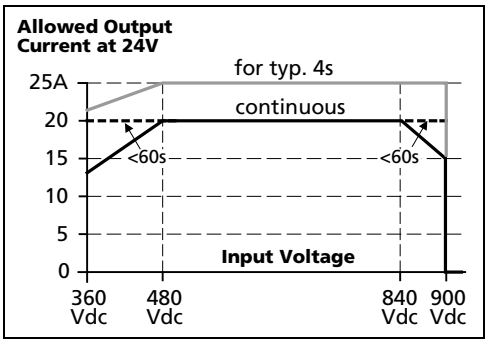


Fig. 5-3 **Bonus time vs. output power**

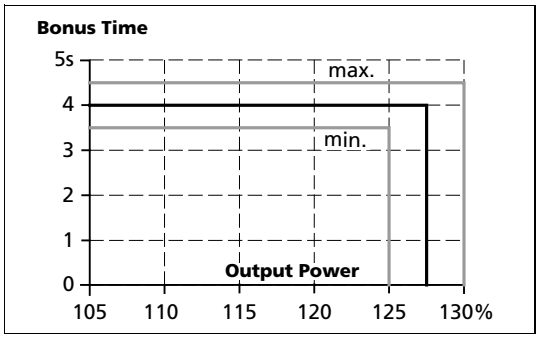
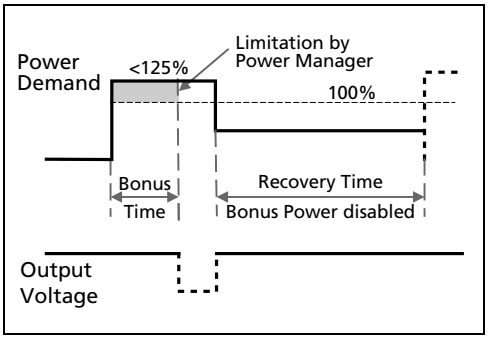


Fig. 5-4 **BonusPower recovery time**



The BonusPower is available as soon as power comes on and after the end of an output short circuit or output overload.

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

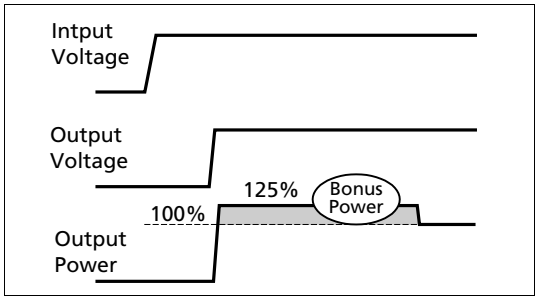
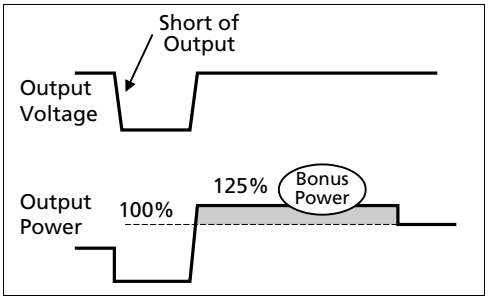


Fig. 5-6 **BonusPower after output short**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

6. HOLD-UP TIME

			DC 600V	
Hold-up Time	typ.	44ms		At 24V, 10A, see Fig. 6-1
	min.	36ms		At 24V, 10A, see Fig. 6-1
	typ.	22ms		At 24V, 20A, see Fig. 6-1
	min.	18ms		At 24V, 20A, see Fig. 6-1

Fig. 6-1 **Hold-up time vs. input voltage**

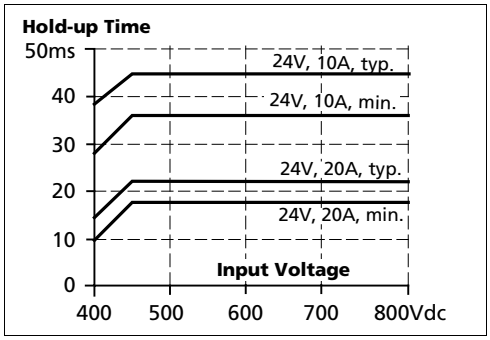
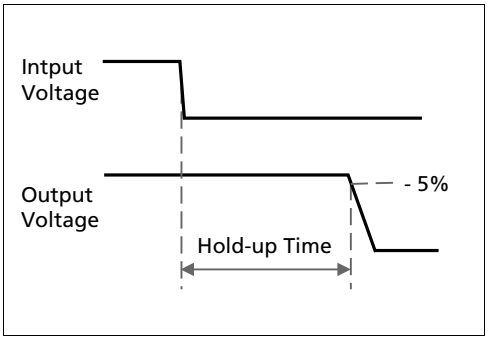


Fig. 6-2 **Shut-down behavior, definitions**

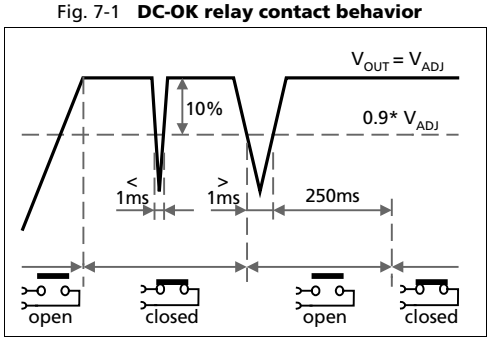


7. DC-OK RELAY CONTACT

This feature monitors the output voltage, which is produced by the DC/DC converter itself. It is independent of a back-fed voltage from a unit connected in parallel to the DC/DC converter output.

Contact closes	As soon as the output voltage reaches 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 chapter 18.		

Fig. 7-1 **DC-OK relay contact behavior**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

8. EFFICIENCY AND POWER LOSSES

		DC 600V	
Efficiency	typ.	95.0%	At 24V, 20A
Average efficiency*)	typ.	94.4%	25% at 5A, 25% at 10A, 25% at 15A and 25% at 20A
Power losses	typ.	7.7W	At 24V, 0A (no load)
	typ.	12.8W	At 24V, 10A (half load)
	typ.	25.5W	At 24V, 20A (full load)

*) The average efficiency is an assumption for a typical application where the DC/DC converter 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. 8-1 **Efficiency vs. output current at 24V, typ.**

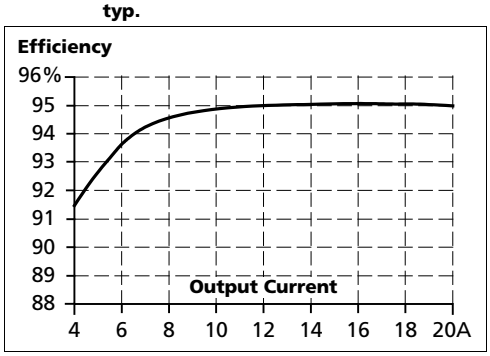


Fig. 8-2 **Losses vs. output current at 24V, typ.**

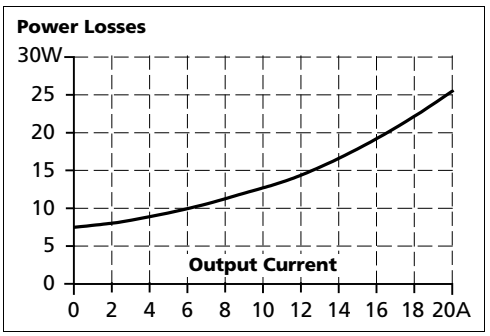


Fig. 8-3 **Efficiency vs. input voltage at 24V, 20A, typ.**

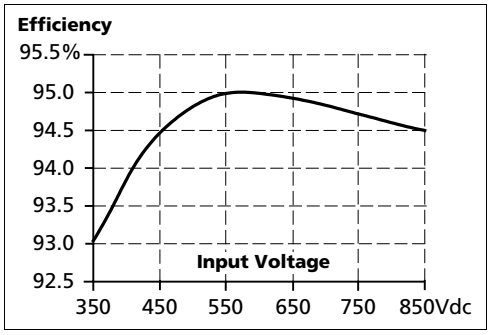
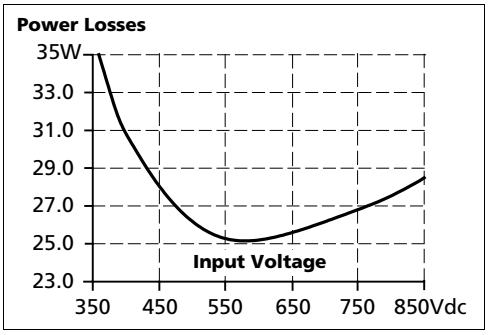


Fig. 8-4 **Losses vs. input voltage at 24V, 20A, typ.**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

9. LIFETIME EXPECTANCY

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.

	DC 600V	
Lifetime expectancy	78 000h	at 24V, 10A and 40°C
	220 000h	at 24V, 10A and 25°C
	42 000h	at 24V, 20A and 40°C
	119 000h	at 24V, 20A and 25°C

10. MTBF

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.

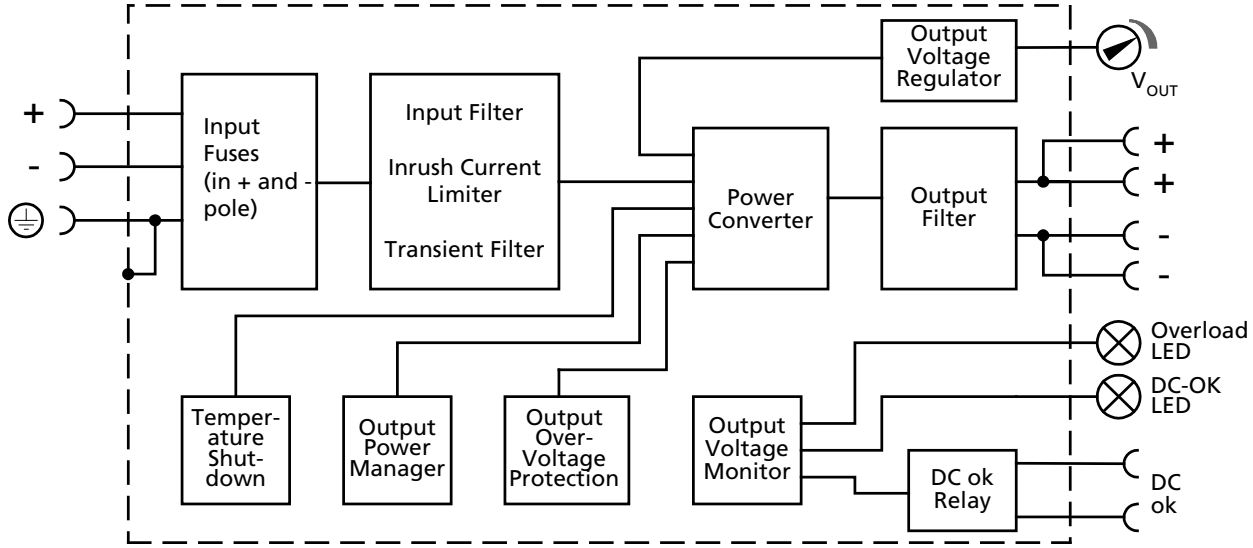
The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

	DC 600V	
MTBF SN 29500, IEC 61709	446 000h	at 24V, 20A and 40°C
	801 000h	at 24V, 20A and 25°C
MTBF MIL HDBK 217F	204 000h	at 24V, 20A and 40°C; Ground Benign GB40
	267 000h	at 24V, 20A and 25°C; Ground Benign GB25

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

11. FUNCTIONAL DIAGRAM

Fig. 11-1 **Functional diagram**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

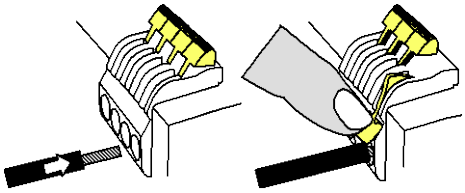
12. TERMINALS AND WIRING

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

Type	Quick-connect spring-clamp terminals
Solid wire	Max. 6mm²
Stranded wire	Max. 4mm²
American Wire Gauge	Max. AWG10
Wire diameter	Max. 2.8mm (including ferrules)
Wire stripping length	Typ. 10mm
Screwdriver	Not applicable
Recommended tightening torque	Not applicable

Instructions:

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
60°C for ambient up to 45°C and
75°C for ambient up to 60°C minimum
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) Ferrules are allowed.



Daisy chaining:

Daisy chaining (jumping from one DC/DC converter output to the next) is allowed as long as the average output current through one terminal pin does not exceed 27A. If the current is higher, use a separate distribution terminal block as shown in Fig. 12-2.

Fig. 12-1 Daisy chaining of outputs

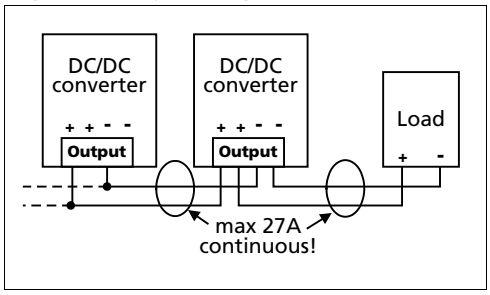
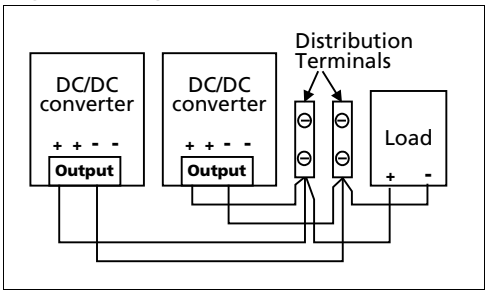


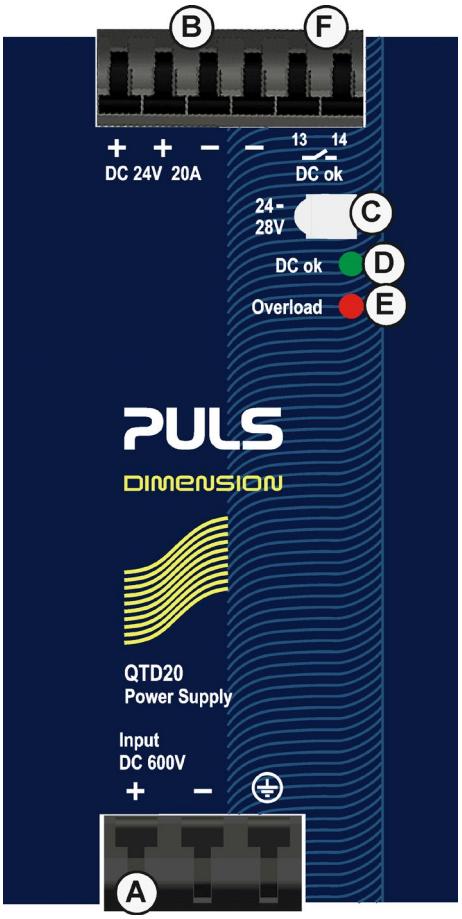
Fig. 12-2 Using distribution terminals



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

13. FRONT SIDE AND USER ELEMENTS

Fig. 13-1 **Front side**



A **Input Terminals**
(Quick-connect spring-clamp terminals)
+ Positive input
– Negative (return) input
⏚ ...PE (Protective Earth) input

B **Output Terminals**
(Quick-connect spring-clamp terminals, two pins per pole)
+ Positive output
– Negative (return) output

C **Output Voltage Potentiometer**
Multi turn potentiometer;
Open the flap to set the output voltage.
Factory set: 24.1V at full output current

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

E **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.
- On, when the unit has switched off due to over-temperature.
- Input voltage is always required

F **DC-OK Relay Contact** (Quick-connect spring-clamp terminals)
The DC-OK relay contact is synchronized with the DC-OK LED.
See chapter 7 for details.

Indicators, LEDs:	Overload LED	DC-OK LED	DC-OK Contact
Normal mode	OFF	ON	Closed
During BonusPower	OFF	ON	Closed
Overload (Vout < 90%)	ON	OFF	Open
Output short circuit	ON	OFF	Open
Temperature Shut-down	ON	OFF	Open
No input power	OFF	OFF	Open

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

14. EMC

The DC/DC converter is suitable for applications in industrial environment.

EMC Immunity	According to generic standards: EN 61000-6-2 and EN 61800-3			
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 DC-OK signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	(+) → (-) (+) / (-) → PE	1kV 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

Criterions:
A: DC/DC converter shows normal operation behavior within the defined limits.

EMC Emission	According to generic standards: EN 61000-6-4 and EN 61800-3	
Conducted emission input lines	EN 55011, EN 55032, FCC Part 15, CISPR 11, CISPR 32	15dB higher than average limits for DC power port according to EN 61000-6-4*)
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	5dB higher than average limits for DC power port according to EN 61000-6-4*)
Radiated emission	EN 55011, EN 55032	Class A

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.

*) There are no mandatory requirements in the generic standards EN 61000-6-4 and EN 61800-3 for conducted emissions on DC-Lines. For assessment of the conducted emissions, the input filter of the frequency converter or servo amplifier need to be taken into account.

Switching Frequencies	The DC/DC converter has three converters with three different switching frequencies included. One is nearly constant. The others are input voltage and load dependent.	
Switching frequency 1	100kHz	Resonant converter, nearly constant
Switching frequency 2	30kHz to 90kHz	Boost converter, load dependent
Switching frequency 3	17kHz to 120kHz	Buck converter, input voltage and load dependent

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

15. ENVIRONMENT

Operational temperature*)	-25°C to +70°C	Reduce output power according Fig. 15-1
Storage temperature	-40 to +85°C	For storage and transportation
Output derating	12W/K	Between +60°C and +70°C
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
Vibration random	0.5m²(s³) 2 hours / axis	IEC 60068-2-64
Shock	30g 6ms, 20g 11ms 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 2000m	Without any restrictions
	2000 to 6000m	Reduce output power or ambient temperature, see Fig. 15-2 IEC 62103, EN 50178, overvoltage category II
Altitude derating	30W/1000m or 5K/1000m	> 2000m, see Fig. 15-2
Over-voltage category	III	IEC 62103, EN 62477-1, altitudes up to 2000m
	II	For altitudes from 2000m to 6000m
Degree of pollution	2	IEC 62103, EN 62477-1, not conductive

*) 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.

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

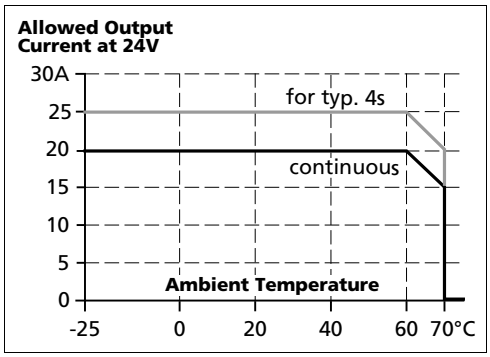
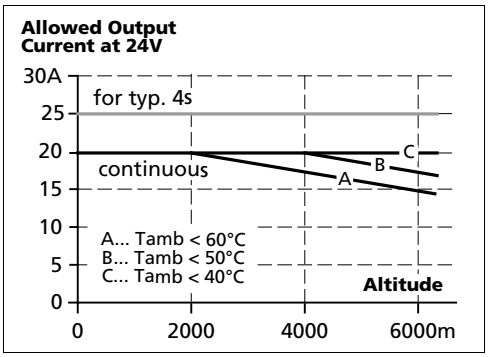


Fig. 15-2 **Output current vs. altitude**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

16. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits*)	
Output over-voltage protection	typ. 32Vdc max. 35Vdc	In case of an internal DC/DC converter defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Reverse input polarity protection	included	Unit does not start when input voltage is reversed.
Degree of protection	IP20	EN/IEC 60529
Penetration protection	> 3.5mm	E.g. screws, small parts
Over-temperature protection	yes	Output shut-down with automatic restart
Input transient protection	MOV (Metal Oxide Varistor)	
Internal input fuse	included	The unit is equipped with two internal input fuses (+ line and - line) which protect the unit against internal short circuits and ground faults. The fuses are not user accessible. A tripping of an internal fuse is caused by an internal fault.

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

17. SAFETY FEATURES

Input / output separation*)	SELV	EN 62477-1
	PELV	IEC/EN 60204-1, EN 62477-1, IEC 62103, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 500MOhm	Input to output, 500Vdc
PE resistance	< 0.1Ohm	
Touch current (leakage current)	The leakage current, which is produced by the DC/DC converter itself, depends on the input voltage ripple and need to be investigated in the final application. For a smooth DC input voltage, the produced leakage current is less than 100µA.	

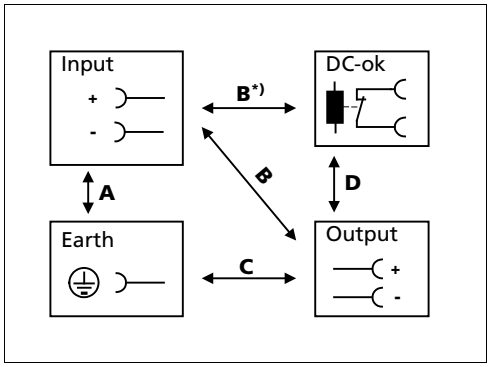
*) double or reinforced insulation

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

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 poles 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	> 30mA	> 1mA

To fulfil the PELV requirements according to EN 60204-1 § 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.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

19. APPROVED, FULFILLED OR TESTED STANDARDS

UL 508	c UL us LISTED	UL Certificate Listed equipment for category NMTR - Industrial Control Equipment Applicable for US and Canada E-File: E198865
IEC 61010-2-201	Safety ✓	Agency Certificate Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
VDMA 24364	LABS VDMA 24364-C1-L/W	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

20. REGULATORY PRODUCT COMPLIANCE

EU Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive - LVD directive
REACH Regulation (EU)	REACH ✓	Manufacturer's Declaration EU regulation regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) fulfilled. EU Regulation (EC) 1907/2006.
WEEE Regulation		Manufacturer's Declaration EU Regulation on Waste Electrical and Electronic Equipment Registered as business to business (B2B) products. EU Regulation 2012/19/EU
KC Certification		The KC mark indicate registered under the Clause 3, Article 58-2 of Radio Waves Art of the Republic of Korea

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

21. PHYSICAL DIMENSIONS AND WEIGHT

Width	65mm
Height	124mm
Depth	127mm The DIN rail depth must be added to the unit depth to calculate the total required installation depth.
Weight	890g
DIN rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Body: Aluminium alloy Cover: Zinc-plated steel
Installation clearances	See chapter 2

Fig. 21-1 **Front view**

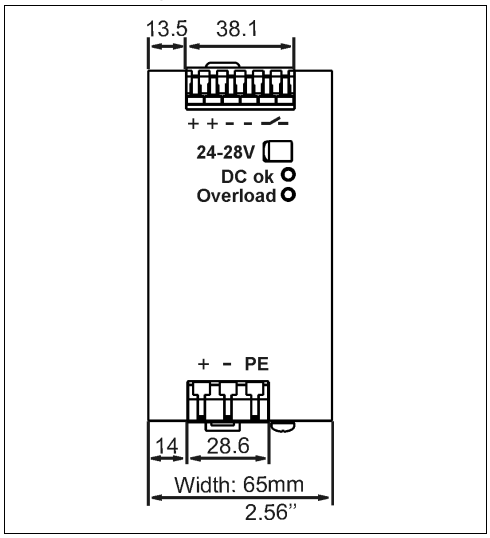
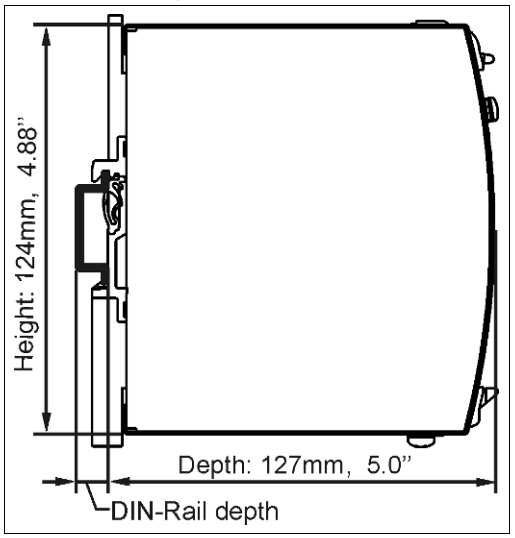


Fig. 21-2 **Side view**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

22. ACCESSORIES

22.1. ZM1.WALL – WALL/PANEL MOUNTING

This bracket is used to mount the QTD20 DC/DC converter on a wall/panel without utilizing a DIN rail.

The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the steel brackets can be mounted.

Fig. 22-1 **Wall/panel mounting**

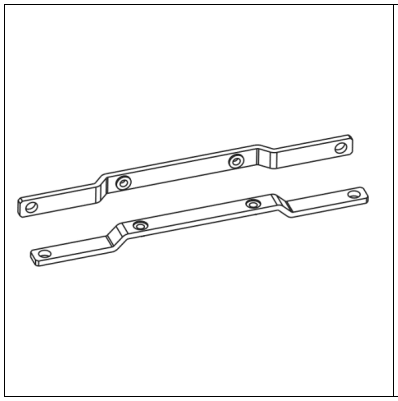


Fig. 22-2 **Wall/panel mounting**

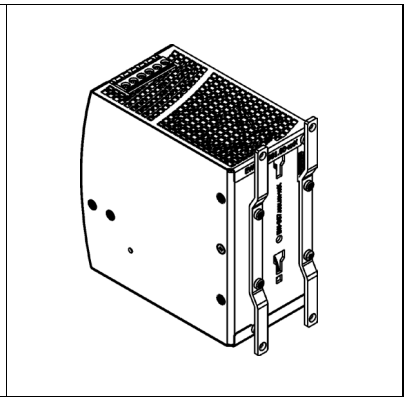
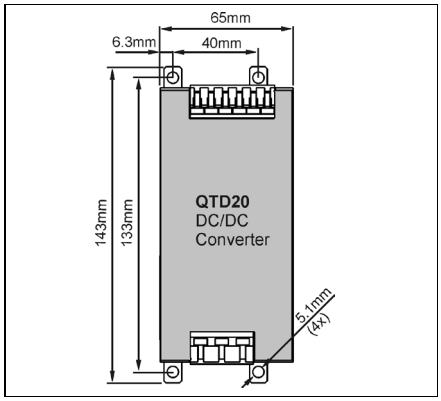


Fig. 22-3 **Mounting Dimensions - Wall mounting bracket**



22.2. ZM14.SIDE - SIDE MOUNTING BRACKET

This bracket is used to mount the QTD20 DC/DC converter sideways with or without utilizing a DIN rail.

The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the steel brackets can be mounted.

For sideway DIN rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the steel bracket.

Fig. 22-4
Side mounting without DIN rail brackets

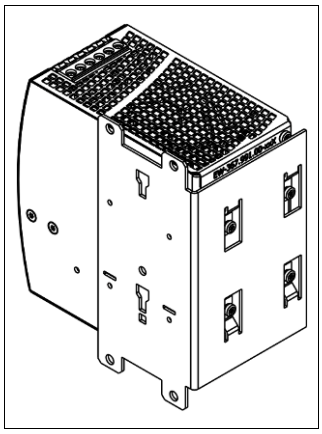


Fig. 22-5
Side mounting with DIN rail brackets

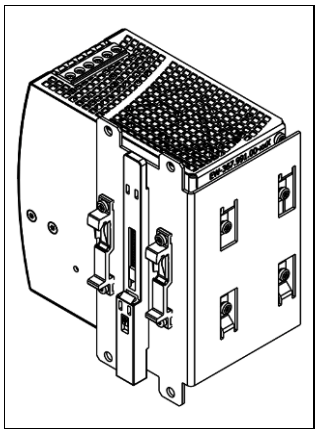
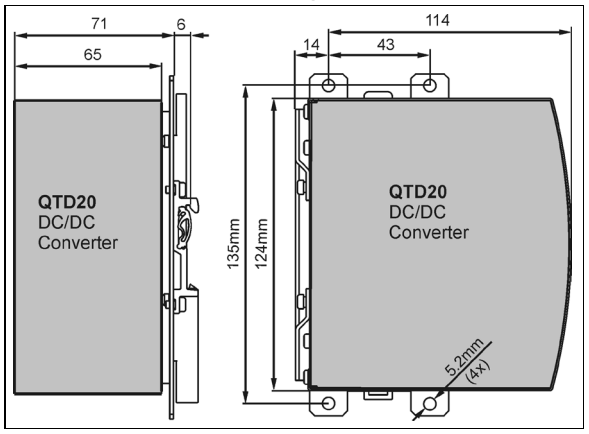


Fig. 22-6
Mounting Dimensions Side mounting bracket



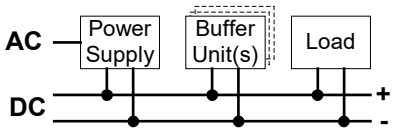
LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

22.3. UF20.241 - BUFFER MODULE



This buffer unit is a supplementary device for DC 24V power supplies and DC/DC converter. It delivers power to bridge typical mains failures or extends the hold-up time after turn-off of the AC or DC power. In times when the DC/DC converter provides sufficient voltages, the buffer unit stores energy in the integrated electrolytic capacitors. In case of mains voltage fault, this energy is released again in a regulated process.

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.



22.4. YR40.241 - REDUNDANCY MODULE



The YR40.241 redundancy module 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 MOSFET instead of diodes reduces the heat generation and the voltage drop between input and output. The YR40.241 does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

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

Fig. 22-7 **Typical 1+1 Redundant configuration for 20A with one dual redundancy module und two DC/DC converters**

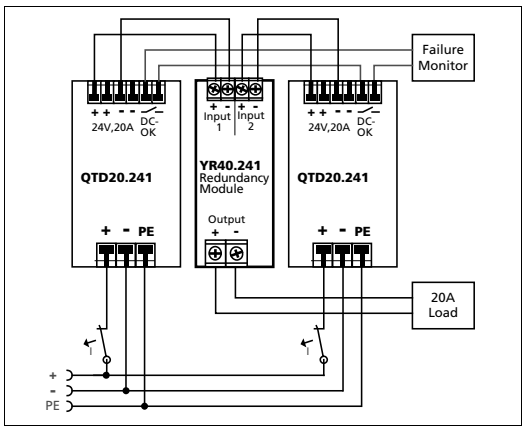
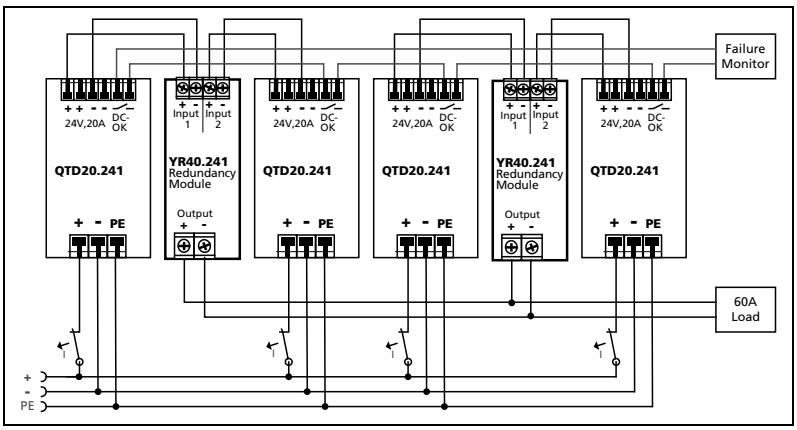


Fig. 22-8 **Typical N+1 Redundant configuration for 60A with two dual redundancy modules and four DC/DC converters**



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23. APPLICATION NOTES

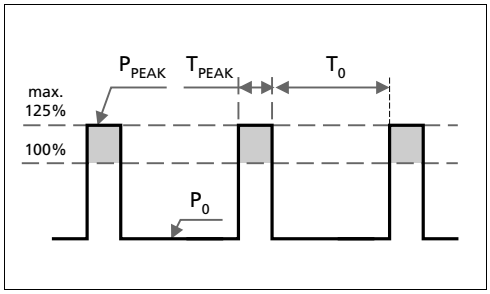
23.1. REPETITIVE PULSE LOADING

Typically, a load current is not constant and varies over time. This DC/DC converter is designed to support loads with a higher short-term power demand (=BonusPower). The short-term duration is hardware controlled by an output power manager and is available on a repeated basis. If the BonusPower load lasts longer than the hardware controller allows it, the output voltage will dip and the next BonusPower is available after the BonusPower recovery time (see chapter 5) has elapsed.

To avoid this, the following rules must be met:

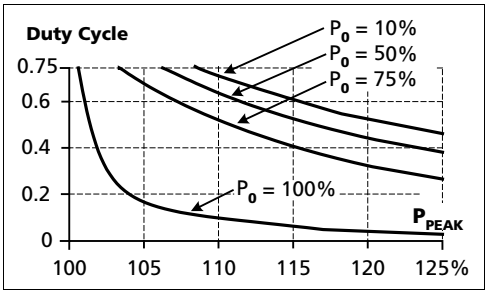
a) The power demand of the pulse must be below 125% of the nominal output power.
b) The duration of the pulse power must be shorter than the allowed BonusPower time. (see output chapter)
c) The average (R.M.S.) output current must be below the specified continuous output current.
If the R.M.S. current is higher, the unit will respond with a thermal shut-down after a period of time. Use the maximum duty cycle curve (Fig. 23-2) to check if the average output current is below the nominal current.
d) The duty cycle must be below 0.75.

Fig. 23-1 **Repetitive pulse loads, definitions**



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

Fig. 23-2 **Max. duty cycle curve**



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

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

Example: A load is powered continuously with 240W (= 50% of the rated output load). From time to time a peak power of 600W (= 125% of the rated output load) is needed for 1 second.

The question is: How often can this pulse be supplied without overloading the DC/DC converter?

- Make a vertical line at P_{PEAK} = 125% and a horizontal line where the vertical line crosses the P_0 = 50% curve. Read the max. duty cycle from the duty cycle-axis (= 0.37)
- Calculate the required pause (base load) length T_0:
- Result: The required pause length = 1.7s
- Max. repetition rate = pulse +pause length = **2.7s**

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

More examples for pulse load compatibility:

P_{PEAK}	P_0	T_{PEAK}	T_0
600W	480W	1s	>25s
600W	0W	1s	>1.3s
540W	240W	1s	> 0.75s

P_{PEAK}	P_0	T_{PEAK}	T_0
600W	240W	0.1s	>0.16s
600W	240W	1s	>1.6s
600W	240W	3s	>4.9s

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23.2. PEAK CURRENT CAPABILITY

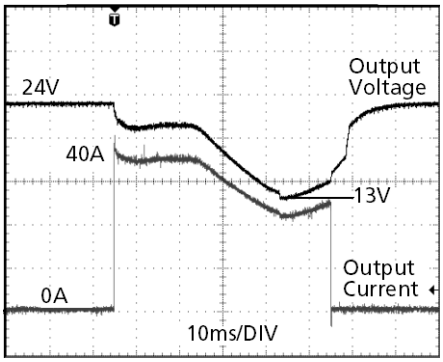
The DC/DC converter can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

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 (including the BonusPower). 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.

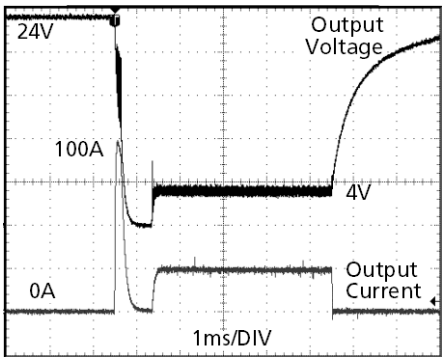
The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the DC/DC converter. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 23-3 **Peak load with 2x the nominal current for 50ms, typ.**



40A Peak load (resistive) for 50ms
Output voltage dips from 24V to 13V.

Fig. 23-4 **Peak load with 5x the nominal current for 5ms, typ.**



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

Please note: The DC-OK relay triggers when the voltage dips more than 10% for longer than 1ms.

Peak current voltage dips	typ.	from 24V to 13V	At 40A for 50ms, resistive load
	typ.	from 24V to 4V	At 80A for 2ms, resistive load
	typ.	from 24V to 4V	At 80A for 5ms, resistive load

23.3. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 15A (U.S.A.) and 16A (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 6A B- or 3A C-Characteristic breaker should be chosen.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23.4. CHARGING OF BATTERIES

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

Instructions for charging batteries:

a) 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

b) Use a 25A circuit breaker (or blocking diode) between the DC/DC converter and the battery.

c) Ensure that the output current of the DC/DC converter is below the allowed charging current of the battery.

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

e) The return current to the DC/DC converter (battery discharge current) is typ. 16mA when the DC/DC converter is switched off (except in case a blocking diode is utilized).

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

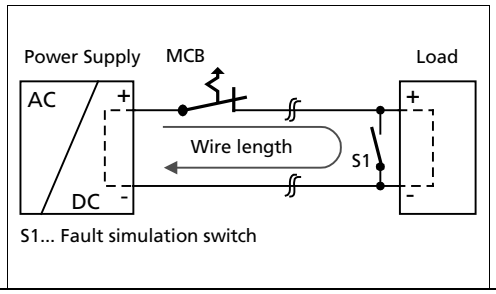
23.5. OUTPUT CIRCUIT BREAKERS

Standard miniature circuit breakers (MCB's or UL1077 circuit breakers) are commonly used for AC-supply systems and may also be used on DC 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 DC/DC converter 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. 23-5 **Test circuit**



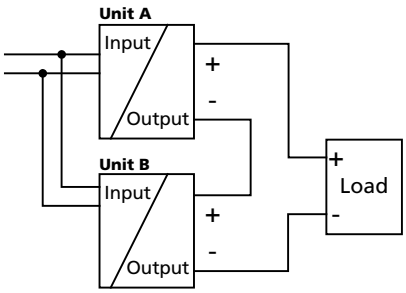
Maximal wire length*) for a fast (magnetic) tripping:

	0.75mm²	1.0mm²	1.5mm²	2.5mm²
C-2A	31m	39m	59m	86m
C-3A	24m	31m	43m	68m
C-4A	15m	15m	32m	41m
C-6A	-	-	-	-
B-6A	16m	25m	34m	58m
B-10A	-	-	-	-

*) Don't forget to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and – wire).

23.6. SERIES OPERATION

DC/DC converters 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.



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

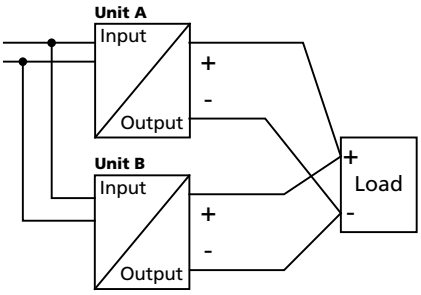
Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in series in mounting orientations other than the standard mounting orientation (input terminals on the bottom of the unit).

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple DC/DC converters.

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23.7. PARALLEL USE TO INCREASE OUTPUT POWER

DC/DC converters and power supplies from the same series (Q-Series) can be paralleled to increase the output power. The output voltage shall be adjusted to the same value (±100mV) or the units can be left with the factory settings.



If more than three units are connected in parallel, a fuse or circuit breaker with a rating of 25A is required on each output. Alternatively, a diode or redundancy module can also be utilized.

Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the DC/DC converters or power supplies on top of each other. Do not use DC/DC converters or power supplies in parallel in mounting orientations other than the standard mounting orientation (input terminals on the bottom of the unit) or in any other condition where a derating of the output current is required (e.g. altitude, above 60°C, …).

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple DC/DC converters.

23.8. PARALLEL USE FOR REDUNDANCY

DC/DC converters 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 DC/DC converter unit fails. The simplest way is to connect two DC/DC converters in parallel. This is called a 1+1 redundancy. In case one DC/DC converter 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 DC/DC converters, each rated for 20A are paralleled to build a 80A redundant system. For N+1 redundancy the same restrictions apply as for increasing the output power, see also chapter 23.7.

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 DC/DC converter. In such a case, the defective unit becomes a load for the other power supplies and the output voltage can not be maintained any more. This can be avoided by utilizing redundancy modules, which have decoupling devices (diodes or MOSFETs) included. Further information and wiring configurations can be found in chapter 22.4.

Recommendations for building redundant power systems:

a) Use separate input fuses for each DC/DC converter. A separate source for each supply when possible increases the reliability of the redundant system.
b) Monitor the individual DC/DC converter units. Therefore, use the DC-OK relay contact of the QTD20.241.
c) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.

23.9. INDUCTIVE AND CAPACITIVE LOADS

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

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23.10. BACK-FEEDING LOADS

Loads such as decelerating motors and inductors can feed voltage back to the DC/DC converter. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

This DC/DC converter is resistant and does not show malfunctioning when a load feeds back voltage to the DC/DC converter. It does not matter whether the DC/DC converter is on or off.

The maximum allowed feed-back-voltage is 34Vdc. The absorbing energy can be calculated according to the built-in output capacitor which is specified in chapter 5.

23.11. USE IN A TIGHTLY SEALED ENCLOSURE

When the DC/DC converter 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 DC/DC converter.

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

The DC/DC converter is placed in the middle of the box, no other heat producing items are inside the box

Enclosure:	Rittal Typ IP66 Box PK 9519 100, plastic, 180x180x165mm
Load:	24V, 16A; (=80%) load is placed outside the box
Input:	600Vdc
Temperature inside enclosure:	54.9°C (in the middle of the right side of the DC/DC converter with a distance of 2cm)
Temperature outside enclosure:	22.6°C
Temperature rise:	32.6K

LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

23.12. MOUNTING ORIENTATIONS

Mounting orientations other than all 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 DC/DC converter. Therefore, two different derating 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. 23-6
Mounting Orientation A
(Standard orientation)

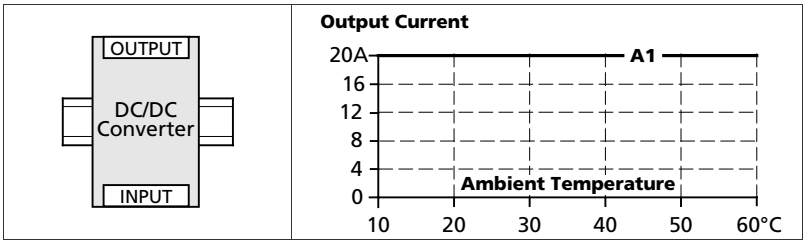


Fig. 23-7
Mounting Orientation B
(Upside down)

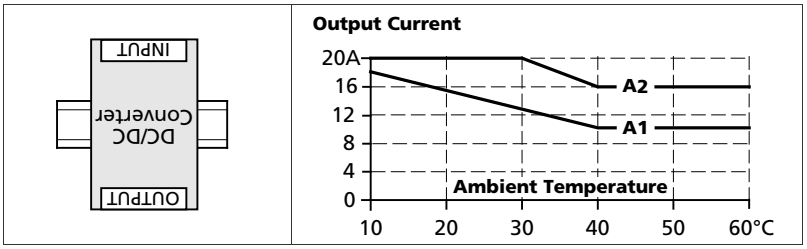


Fig. 23-8
Mounting Orientation C
(Table-top mounting)

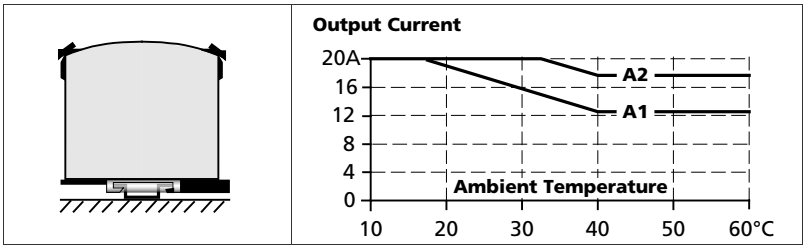


Fig. 23-9
Mounting Orientation D
(Horizontal cw)

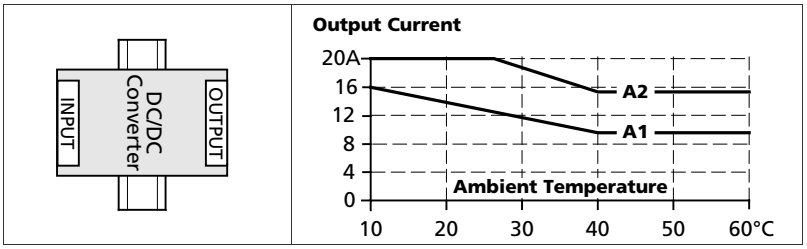
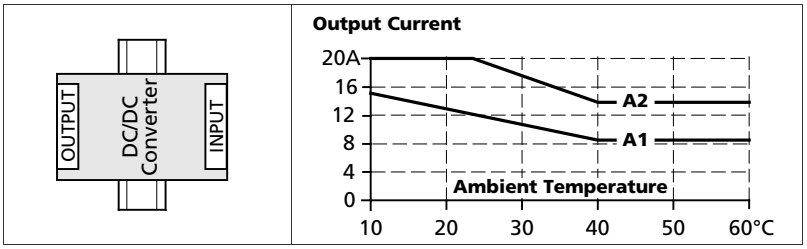


Fig. 23-10
Mounting Orientation E
(Horizontal ccw)



LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000