TDK·Lambda

Technical Specification

DUSH960-1248-0M
DUSH960-1248-1M

Uninterruptible DC Power Supplies
20A / 12..48VDC

Industries & Applications

Automation | Industrial | Semi-Fab | Renewable | Comms | Test

ePLAN data portal

Features & Benefits

- **Wide input & output range** for various applications
- **Decoupled load and battery voltages** by integrated DC/DC buck/boost converter
- **Usable capacity up to 1000Ah** with lead, nickel and lithium batteries or supercaps
- **Continuous battery protection** by NTC sensor, SoC monitoring and Ri measuring
- **Convenient commissioning and maintenance** via LCD or PowerCMC software
- **System monitoring and control** via Modbus/RTU with comprehensive settings, measurings and status parameters
- **Push-in terminals** for durable connection quality and vibration resistance
- **High efficiency and low stand-by losses** contribute to an eco-friendly energy footprint
- **Status relays and inhibit contacts** for professional integration into applications control architecture

Technical data abstract[1]

Output voltage	*nom.*	12..48VDC
Output voltage range	*max.*	10..58VDC
Output current	*nom.*	20A
Input voltage	*nom.*	12..48VDC
Input voltage range	*max.*	10..60VDC
Charge current range	*max.*	0.5..20A
Discharge current	*max.*	21A
Storage technologies		Lead, Nickel, Lithium, Supercaps
Battery voltage	*nom.*	12..48VDC
Charge voltage range	*max.*	10..58VDC
Deep discharge voltage range	*max.*	5..58VDC
Battery capacity range	*max.*	1..1000Ah
Output power	*max.*	960W
Conversion efficiency[3]	*min.*	98.9%
Power losses[3]	*max.*	10.6W
No load consumption[4]	*max.*	0.9W
Ambient operating temperature	*max.*	-25..+70°C (-13..+158°F)
	nom.	-25..+50°C (-13..+122°F)
Service life MTBF[5]	*min.*	320 000hrs
Early life MTBF[5]	*min.*	210 000 hrs
Communication interface		Modbus/RTU + Mini USB
Width		54mm (2 1/8in)
Height		115mm (4 17/32in)
Depth		131.2mm (5 11/64in)
Weight	*max.*	500g (1.10lb)

[1] All values refer to STC unless otherwise stated | [3] 48VDC, 100% P_{out_nom}, normal operation | [4] 48VDC, 0% P_{out_nom}, normal operation | [5] 25°C_{amb}, 100% P_{out_nom}

Certifications & Approvals

IECEE CB SCHEME
IEC EN 61010-1
IEC EN 61010-2-201
IEC EN 62368-1 (Ed.3)

c UL us LISTED
UL CSA 61010-1
UL CSA 61010-2-201
E356563

c UL us
UL CSA 62368-1 (Ed.3)
E511889

Compliance & Registration

CE
EU Low Voltage Dir. 2014/35/EU
EU EMC Dir. 2014/30/EU
EU RoHS Dir. 2011/65/EU

UK CA
Safety and EMC Reg. 2016
Hazard. Substances Reg. 2012

China RoHS Law SJ/T 11363-2006

emea.lambda.tdk.com/dush-series

Commercial information

Order codes	DUSH960-1248-0M DUSH960-1248-1M
HS code	8504408390
Life-cycle status	Launch
Product revision	E01
Single package	
Width	71mm ($2^{25}/_{32}$in)
Height	182mm ($7^{3}/_{32}$in)
Depth	166mm ($6^{17}/_{32}$in)
Gross weight	
-0M model	635g (1.40lb)
-1M model	605g (1.33lb)
Bulk package	
Width	310mm ($13^{25}/_{64}$in)
Height	210mm ($8^{5}/_{64}$in)
Depth	343mm ($15^{15}/_{16}$in)
Quantity	8 units
Pallet	
Width	1000mm ($39^{3}/_{8}$in)
Height (fully packed)	1080mm ($42^{33}/_{64}$in)
Length	1200mm ($47^{1}/_{4}$in)
Quantity	216
Manufacturer warranty	3 years

Model selector

Model name	Output Power	Output Voltage	Feature
DUSH960-1248-0M	960W	12..48V_{DC}	1.5” colour LCD, AUX output
DUSH960-1248-1M	960W	12..48V_{DC}	

Add-ons and accessories

Temperature Sensor

Optional temperature sensor for battery monitoring and temperature compensated charging of the battery.

ACC-DUSH-DTX01-0X
10kOhm NTC sensor with plug connector, cable length 1m

ACC-DUSH-DTX02-0X
10kOhm NTC sensor with plug connector, cable length 2m

DBM Buffer Modules

In order to secure process uptime and reliability in 24V low-voltage systems, DBM buffer modules increase hold-up time or provide a reserve for peak loads.

DBM20
Buffer module, input/output 20A, electrolytic capacitors, signalling & control, screw terminals

DBM20/E
Buffer module, input/output 20A, electrolytic capacitors, signalling & control, spring terminal blocks

WWW.EMEA.LAMBDA.TDK.COM/UK/PRODUCTS/DBM20

DDA DC/DC Converters

Non-isolated step-down converters for creating additional DC bus voltages from a single DC input source.

DDA250N
Single output 20A at 3.3 .. 15V, input 9 .. 53V, DC OK LED, screw terminals

DDA325N
Dual output 14A at 3.3 .. 24V and 8A at -3.3 .. -24V, input 9 .. 40V, DC OK LEDs, screw terminals

DDA500N
Dual output 2x20A at 3.3 .. 15V, input 9 .. 53V, DC OK LEDs, screw terminals

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DRB Power Supplies

Single- or three-phase power supplies with compact dimensions and energy saving efficiencies.

DRB480-24-1
Power supply, input 100 .. 240V_{AC}, output 24V_{DC}/20A, DC-OK, screw terminals

DRB480-48-1
Power supply, input 100 .. 240V_{AC}, output 48V_{DC}/10A, DC-OK, screw terminals

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DRB480-24-3-Ax
Power supply, input 3x400 .. 500V_{AC}, output 24V_{DC}/20A, DC-OK, INHIBIT, screw or push-in terminals

DRB480-48-3-Ax
Power supply, input 3x400 .. 500V_{AC}, output 48V_{DC}/10A, DC-OK, INHIBIT, screw or push-in terminals

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DRB960-48-3-Ax
Power supply, input 3x400 .. 500V_{AC}, output 48V_{DC}/10A, DC-OK, INHIBIT, screw or push-in terminals

WWW.EMEA.LAMBDA.TDK.COM/UK/PRODUCTS/DRB-3-PHASE-SERIES

PowerCMC
Control and monitoring center software via Modbus/RTU and USB.

Index

List of abbreviations

avg.	*average*	The arithmetic average calculated from a row of values.
CC		Constant output current
chap.		Chapter
Dir.		Directive
eCap		Electrolytic capacitor
EMC		Electromagnetic Compatibility
Iout		DC output current under a particular operating condition
Iout_boost		Available current reserve beyond Iout_nom (w/o a drop in Uset) that can be delivered for a limited time.
Iout_nom		Continuous nominal DC output current under STC.
Iout_ol		Max. intermittent DC output current in an overload situation and a shortfall of Uset.
Iout_sc		Max. short circuit DC output current and Uout close to zero.
max.	*maximum*	The maximum value which a parameter can assume, or which must not be exceeded.
MCB		Miniature circuit breaker
min.	*minimum*	The minimum value which a parameter can assume, or must not be fallen below.
MTBF		Mean Time Between Failure
nom.	*nominal*	The ideal or reference value of a technical parameter which is guaranteed under STC. All nominal values in this document refer to each other and represent the general specification of the device.
OCP		Overcurrent protection
OTP		Overtemperature protection
OVP		Overvoltage protection
PELV		Protective Extra Low Voltage
Pout		Output power under a particular operating condition with reference to Pout_nom
Pout_boost		Available power reserve beyond Pout_nom that can be delivered for a limited time.
Pout_nom		Nominal output power
UPS		Uninterruptible power supply
Reg.		Regulation
SELV		Safety Extra Low Voltage
STC		Standard test conditions (see „1. General“ on page 5)
typ.	*typical*	The typical value of a parameter is not guaranteed but can be assumed under STC. The min. or max. value must be determined during the engineering process of the end application.
Uout		DC output voltage under a particular operating condition
Uout_nom		Nominal DC output voltage
Uset		Manually set output voltage via voltage potentiometer
UVP		Undervoltage protection
/		Separator between two values. The conditions to which the values refer can be found in the last column of the table.
..		Specifies a range of values.
<		The parameter is less than or equal to the specified value
>		The parameter is greater than or equal to the specified value

Table data structure

X. Technical category			
Technical parameter	Characteristic (optional)	Values	Condition (optional)

1. General

1.1 Proper handling of the product
The faultless and safe operation of the products requires proper transport, proper storage, set-up, assembly, installation, commissioning, operation and maintenance. The permissible ambient conditions must be observed. Instructions in the associated documentation must be observed.

1.2 Protection enclosure required
The device must be installed in a protective housing or control cabinet to which only qualified personnel have access.

1.3 Humid environments
Do not operate the device in a damp environment or in an environment where condensation is likely to occur.

1.4 Wiring protection
It is essential to ensure that a suitably sized DC type circuit breaker is installed on the input, output and battery wiring.

1.5 Observe country-specific regulations
In addition to the product documentation, the relevant country-specific regulations for the installation of the device must be observed.

1.6 Prohibited electrical/mechanical modifications
The product must not be modified in any way electrically or mechanically. Modifications can result in fatal injuries and damage to property.

1.7 Expiry of the manufacturer's warranty
The power supply is maintenance-free. Repairs can only be carried out by the manufacturer. Opening the housing voids the manufacturer's warranty.

1.8 Use of third-party products
If third-party products and components are used for power or voltage increase, buffering (AC or DC side), EMC filtering, redundancies or for DC side load protection, it must be in accordance with the TDK-Lambda product specification.

1.9 Standard test conditions
Unless otherwise stated, all values are specified at nominal input and output voltages, fully charged battery, normal mounting position, at full load, 25°C (77°F) ambient temperature and a run-in time of 5 minutes.

1.10 Selection of an appropriate power supply
Use an appropriately sized power supply, which can deliver the additional required internal current consumption of the DC-UPS and the required current for charging the batteries. Use power supplies that do not deliver more than 20A continuous output current (check max. current input).

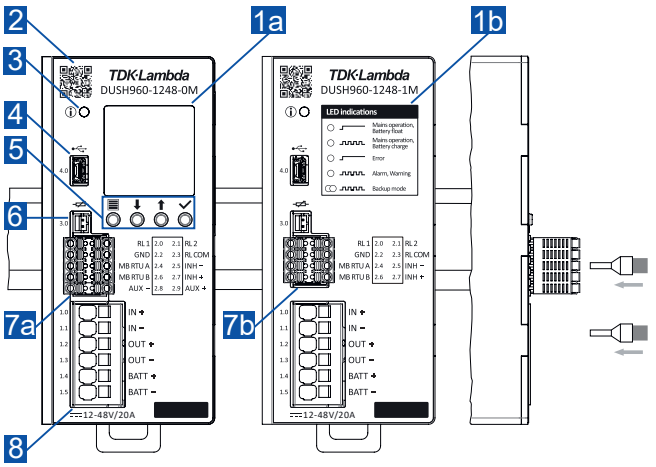
1.11 Built-in battery
A CR2032 button battery cell is used in the DUSH to provide real time stamps in the log file informations. A lithium battery mark is not required for packages prepared in accordance with Section II of PI 967 or PI 970 containing only button cell batteries installed in equipment (including circuit boards).

1.12 Cyber security
Due to cyber security reasons only use the DUSH DC-UPS system in your internal network. Do not connect the DUSH to the internet.

1.13 User manual
For further information on updating, setting up, installing and operating the unit, please read our detailed user manual.

1.14 Update to current firmware
To guarantee the safe and seamless operation of the DUSH, it is imperative to utilise the most recent versions of both the PowerCMC software and the DUSH firmware. It is also necessary to configure the system before using it in a field application.

1.15 Description of user elements



- 1a 1.5" colour LCD
- 1b LED indication info
- 2 Web link to product documentation
- 3 Alarm LED
- 4 Mini USB terminal 4.0
- 5 Navigation keys
- 6 Pluggable terminal 3.0 (temperature sensor)
- 7a Pluggable push-in terminal 2.x (alarm relays, Modbus/RTU, inhibit, AUX)
- 7b Pluggable push-in terminal 2.x (alarm relays, Modbus/RTU, inhibit)
- 8 Push-in terminal 1.x (input, output, battery)

For more detailed information on the input/ouput wiring and the connection of the signalling contacts, please refer to „Wiring & Connection" on page 17.

Fig. 1: Description of user elements

2. Electrical output

2.1 Normal operation

The DUSH is in a state of normal operation as long as an input voltage from an installed power supply is present on the input. In this state, the input to output path of the DUSH is active. It should be noted that this path is not regulated. Furthermore, there is no protection on the input to output path. Therefore, it is essential to utilise a suitable power supply and input protection on the input of the DUSH. The internal monitoring and alarm functions are based on a constant measurement of the voltage and current on the input and output.

Output voltage [Uout_nom]	*nom.*	12 .. 48VDC	
Output voltage range [Uset]	*max.*	10 .. 58VDC	
Voltage adjustment steps	*max.*	0.1VDC	
Output current [Iout_nom]	*nom.*	20A	
Boost current	*max.*	21A / continous	
Current adjustment steps		0.1A	
Auxiliary output voltage range*	*max.*	5 .. 58VDC	equal to battery discharge voltage (non-regulated)
Auxiliary output current*	*nom.*	5A	
Overload behaviour		non-regulated	refer to the input power supply
Short circuit proof		No	
Start-up delay	*max.*	2.2s	
Rise time	*typ.*	20ms	
Fall time	*typ.*	5ms	
Voltage drop B-N	*typ.*	0VDC	switching from backup mode to normal operation
Voltage drop I-O	*max.*	10mV	input to output path
Output capacitance	*max.*	200µF	
Capacitive load start-up	*max.*	2,000µF	
Feedback voltage	*max.*	0VDC	non-regulated

*only DUSH960-1248-0M

2.2 Backup mode

In the event of a power outage, the DUSH will switch to backup mode. In this state, the battery to output path of the DUSH is active. This path is regulated by a bidirectional DC/DC buck/boost converter. The load is now safely powered from the installed energy storage, such as a battery or a supercapacitor. A constant measurement of the voltage and current on the input and output is used for the internal monitoring and alarm functions.

Output voltage [U_{out_nom}]	*nom.*	12 .. 48V_{DC}	
Output voltage range [U_{set}]	*max.*	10 .. 58V_{DC}	
Voltage adjustment steps	*max.*	0.1V_{DC}	
Output current [I_{out_nom}]	*nom.*	20A	
Boost current	*max.*	21A / continous	
Current adjustment steps		0.1A	
Auxiliary output voltage range*	*max.*	5 .. 58V_{DC}	equal to battery discharge voltage (non-regulated)
Auxiliary output current*	*nom.*	5A	
Overload behaviour		Constant current	
Short-circuit proof		Yes, Hiccup	
Start-up delay	*max.*	2.6s	cold start in backup mode by inhibit toggle
Rise time	*typ.*	150ms	
Fall time	*typ.*	10ms	
Backup start threshold	*max.*	80 .. 95%	of nominal output voltage
Switching time to backup	*max.*	20ms	
Voltage drop N-B	*typ.*	8V_{DC}	switching from normal operation to backup mode
Output capacitance	*max.*	2,400µF	
Capacitive load start-up	*max.*	20,000µF	
Feedback voltage	*max.*	8V_{DC}	
Load regulation	*max.*	1%	
Dynamic response	*typ.*	1,500mVpp	12 .. 55V_{DC}, 10 .. 100% P_{out_nom}, transient frequency 10Hz
Ripple & noise voltage	*max.*	310mVpp	-25 .. +70°C_{amb}
	max.	690mVpp	-25 .. +25°C_{amb}

*only DUSH960-1248-0M

In order to guarantee the optimal functionality of the DUSH, it is essential to configure the system parameters through one of the following methods: PowerCMC, Modbus, or directly on the device. Otherwise, the DUSH may enter an error state.

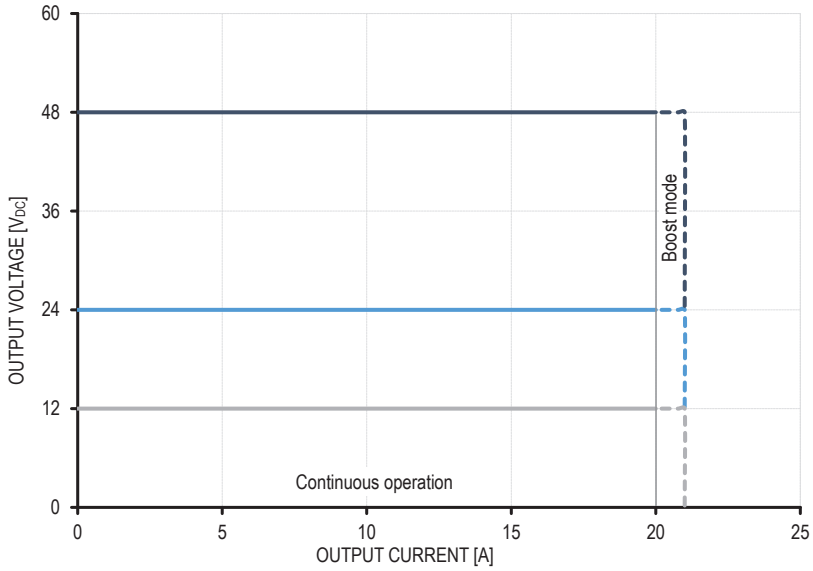


Fig. 2: Output voltage in dependence of output current

3. Electrical input

Input voltage [Uin_nom]	*nom.*	12 .. 48V_{DC}
Input voltage range	*max.*	10 .. 60V_{DC}
Turn-ON voltage	*min.*	11V_{DC}
Turn-OFF voltage	*max.*	7V_{DC}
Input current	*max.*	20A
Input capacitance	*max.*	22µF

ⓘ Consider machinery directive EN 60204-1, for temparatures >40°C current-carrying capacities of the respective cables must be observed.

ⓘ In order to guarantee the optimal functionality of the DUSH, it is essential to configure the system parameters through one of the following methods: PowerCMC, Modbus, or directly on the device. Otherwise, the DUSH may enter an error state.

4. Performance

Output power	*nom.*	240W	12VDC
	nom.	480W	24VDC
	nom.	960W	48VDC
Boost power	*max.*	252W / continuous	12VDC
	max.	504W / continuous	24VDC
	max.	1008W / continuous	48VDC
Conversion efficiency			
100% P_{out_nom}, normal operation	*min.*	96.2%	12VDC
	min.	98.1%	24VDC
	min.	98.9%	48VDC
25..100% P_{out_nom}, normal operation	*avg.*	97.4%	12VDC
	avg.	98.7%	24VDC
	avg.	99.2%	48VDC
100% P_{out_nom}, backup mode	*min.*	92.7%	12VDC
	min.	96.1%	24VDC
	min.	97.7%	48VDC
25..100% P_{out_nom}, backup mode	*avg.*	94.3%	12VDC
	avg.	97.0%	24VDC
	avg.	98.0%	48VDC
Power losses			
100% P_{out_nom}, normal operation	*max.*	9.5W	12VDC
	max.	9.3W	24VDC
	max.	10.7W	48VDC
25..100% P_{out_nom}, normal operation	*avg.*	6.4W	12VDC
	avg.	6.3W	24VDC
	avg.	7.7W	48VDC
100% P_{out_nom}, backup mode	*max.*	18.9W	12VDC
	max.	19.5W	24VDC
	max.	22.6W	48VDC
25..100% P_{out_nom}, backup mode	*avg.*	14.5W	12VDC
	avg.	14.8W	24VDC
	avg.	19.6W	48VDC
No load consumption	*max.*	0.7W	12VDC, 0% Pout_nom, normal operation
	max.	0.7W	24VDC, 0% Pout_nom, normal operation
	max.	0.9W	48VDC, 0% Pout_nom, normal operation

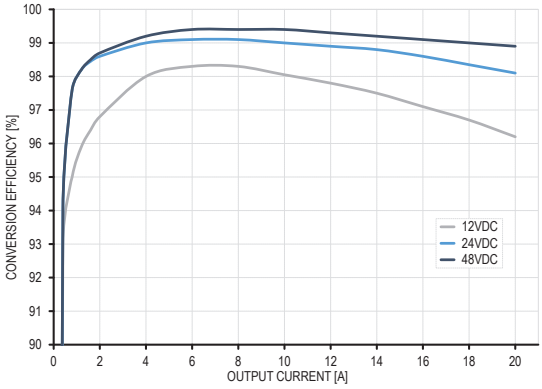


Fig. 3: Normal operation - Conversion efficiencies for different output voltages in dependence of the output current

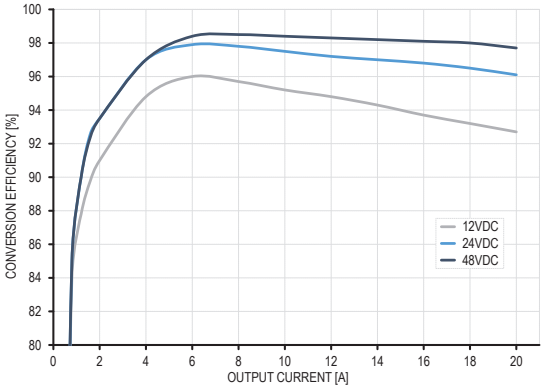


Fig. 4: Backup mode - Conversion efficiencies for different output voltages in dependence of the output current

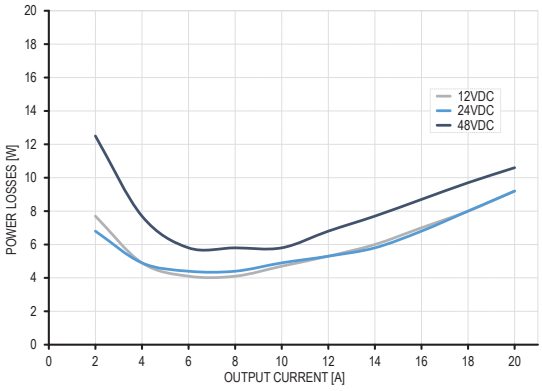


Fig. 5: Normal operation - Power losses for different output voltages in dependence of the output current

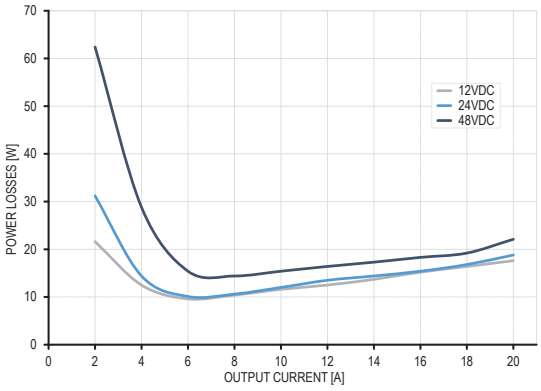


Fig. 6: Backup mode - Power losses for different output voltages in dependence of the output current

Unless otherwise stated, all values are specified in normal mounting position, at full load, nominal input and output voltages, 25°C (77°F) ambient temperature and a run-in time of 5 minutes.

5. Energy storage

Battery voltage	*nom.*	12 .. 48VDC	
Float voltage range	*max.*	10 .. 58VDC	
Charge voltage range	*max.*	10 .. 58VDC	
Deep discharge voltage range	*max.*	5 .. 58VDC	
Charge current range	*max.*	0.5 .. 20A	
Discharge current range	*max.*	0.5 .. 21A	
Energy storage technologies		Lead, Nickel, Lithium, Supercaps	DUSH firmware provides respective charging profiles
Battery capacity range	*max.*	1 .. 1000Ah	
Internal resistance range		0 .. 300mΩ	
Temperature monitoring range	*max.*	-40 .. +60°C	

5.1 Monitoring features

Internal resistance	Yes	
Battery temperature	Yes	via external temperature sensor (see „Add-ons and accessories“ on page 3)
Operating time	Yes	since installation
Number of cycles	Yes	
Coulomb counter	Yes	

5.2 Protection features

Battery input	Yes, integrated DC fuse 25A	not user replacable
Reverse polarity	Yes	
Deep discharge	Yes	
Over-/undertemperature	Yes	
Temperature compensated charging	Yes	via external temperature sensor (see „Add-ons and accessories“ on page 3)

ⓘ In order to guarantee the optimal functionality of the DUSH, it is essential to configure the system parameters through one of the following methods: PowerCMC, Modbus, or directly on the device. Otherwise, the DUSH may enter an error state.

6. Ambient conditions

Ambient storage temperature	*max.*	-40 .. +85°C$_{amb}$ (-40 .. +185°F$_{amb}$)	
Ambient operating temperature	*max.*	-25 .. +70°C$_{amb}$ (-13 .. +158°F$_{amb}$)	
	nom.	-25 .. +50°C$_{amb}$ (-13 .. +122°F$_{amb}$)	48V$_{DC}$, 100% Pout_nom, normal mounting position
	nom.	-25 .. +35°C$_{amb}$ (-13 .. +95°F$_{amb}$)	48V$_{DC}$, 100% Pout_nom, rotated ±90° around X or Y axis
	nom.	-25 .. +40°C$_{amb}$ (-13 .. +104°F$_{amb}$)	48V$_{DC}$, rotated 180°
Power derating*	*min.*	12W/°Camb (6.67W/°Famb)	48V$_{DC}$, normal mounting position
	min.	9.6W/°Camb (5.33W/°Famb)	48V$_{DC}$, rotated ±90° around X or Y axis
	min.	11.2W/°Camb (6.22W/°Famb)	48V$_{DC}$, rotated 180°
Cooling concept		Natural convection	
Relative storage humidity IEC 60068-2-30	*max.*	95%	non-condensing
Relative operation humidity IEC 60068-2-30	*max.*	95%	non-condensing
Operating altitude	*nom.*	3000mASL (9842ftASL)	
	max.	6000mASL (19685ftASL)	not UL approved, reduced OVC
Percental power derating	*min.*	5% per 1000m (5% per 3281ft)	48V$_{DC}$, >3000mASL (>9842ftASL)
Temperature derating	*min.*	5°C per 1000m (9°F per 3281ft)	48V$_{DC}$, >3000mASL (>9842ftASL)
Atmospheric pressure	*nom.*	689hPa	
	max.	469 .. 1070hPa	
Pollution degree		2	
Vibration sinusoidal IEC 60068-2-6		2g / 10 .. 500Hz, 2hour/direction X,Y,Z	mounted on DIN rail
Shock test sinosoidal halfwave IEC 60068-2-27		30g / 11ms ±5ms, 2 bumps/direction, 9 bumps total	mounted on DIN rail
Audible noise		Some audible noises may be heard during no load, overload or short circuit.	

* Not actively controlled

ⓘ For altitudes above 3000mASL (9842ftASL) the next lower OVC must be considered.

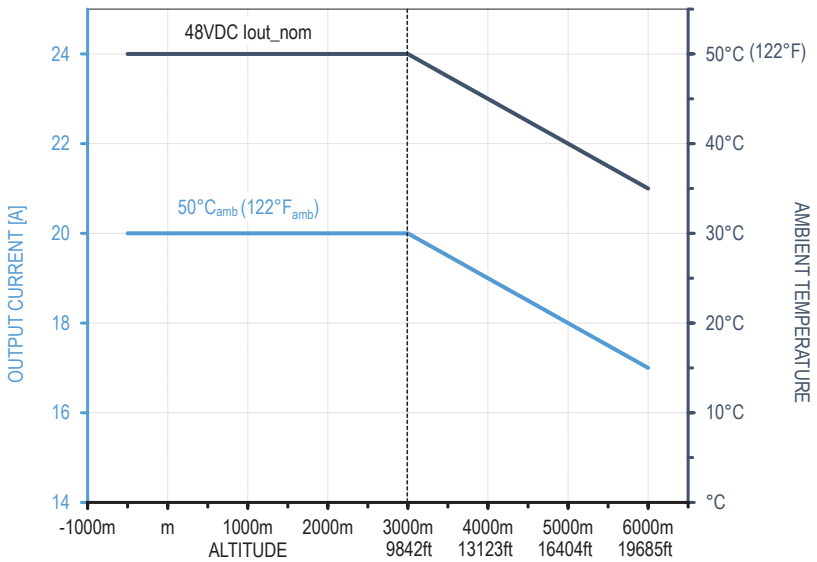
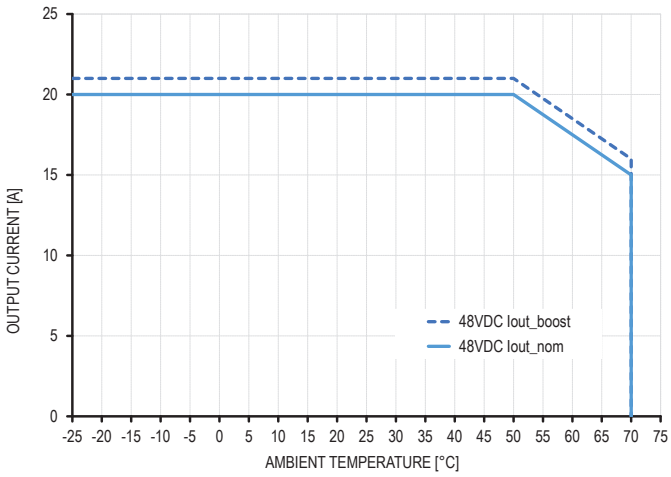


Fig. 7: Output current and ambient temperature derating at increasing altitudes



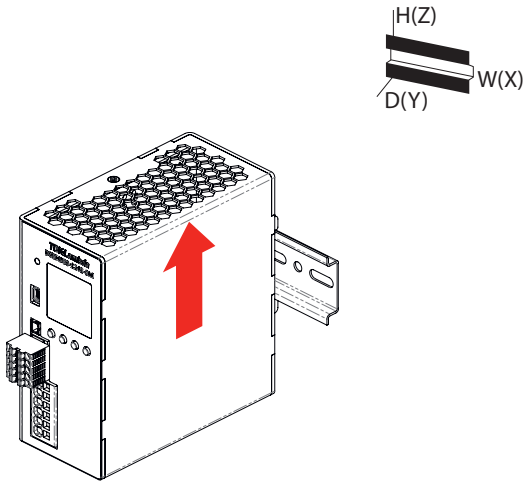
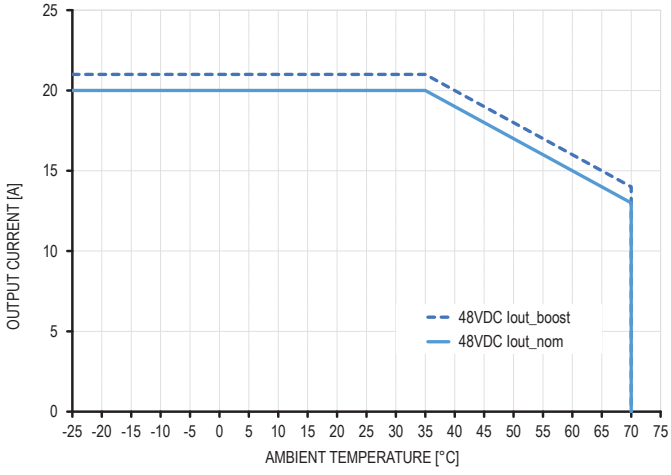


Fig. 8: Permitted output current in dependence of the ambient temperature for normal mounting position



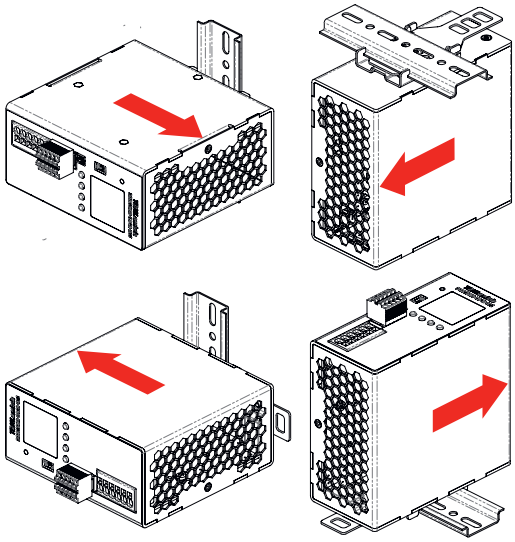
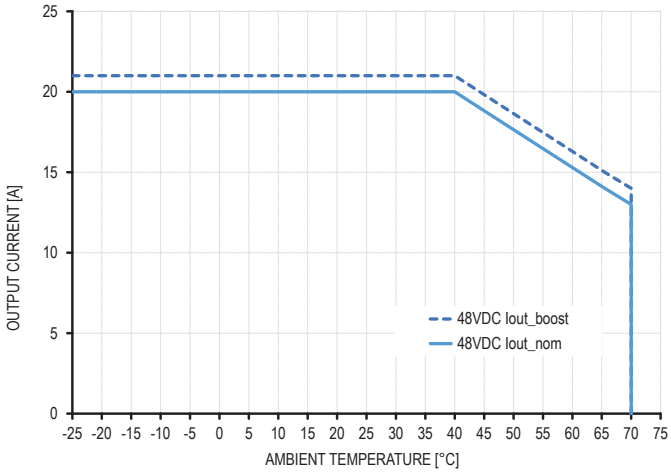


Fig. 9: Permitted output current in dependence of the ambient temperature for 90° rotated mounting positions



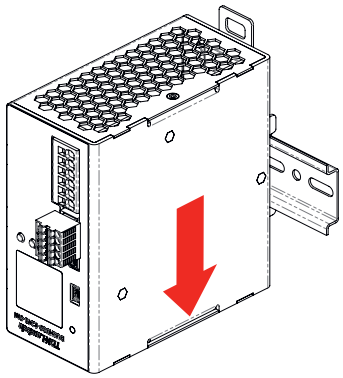


Fig. 10: Permitted output current in dependence of the ambient temperature for 180° rotated mounting positions

7. Reliability and Service lifetime

Service lifetime	*min.*	174 000hrs	24V_{DC}, Iout_nom, backup mode, 25°C_{amb}, 24/7
	min.	61 000hrs	24V_{DC}, Iout_nom, backup mode, 40°C_{amb}, 24/7
Service life MTBF Telcordia SR-332 Issue 4	*min.*	2,63 / 1,93 / 0,74M hrs	25 / 40 / 70°C_{amb}, 50% Iout_nom
	min.	0,32 / 0,24/ 0,11M hrs	25 / 40 / 70°C_{amb}, Iout_nom
Early life MTBF Telcordia SR-332 Issue 4	*min.*	0,52 / 0,48 / 0,34M hrs	25 / 40 / 70°C_{amb}, 50% Iout_nom
	min.	0,21 / 0,17 / 0,09M hrs	25 / 40 / 70°C_{amb}, Iout_nom

The maximum service lifetime guaranteed by the eCap manufacturer is 131400hrs (15 years). All values above are theoretically calculated.

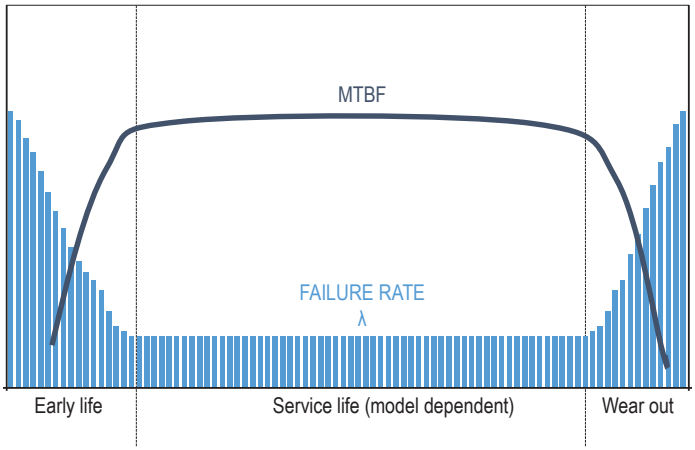


Fig. 11: Generic diagram visualising failure rate and MTBF values during the products life-cycle

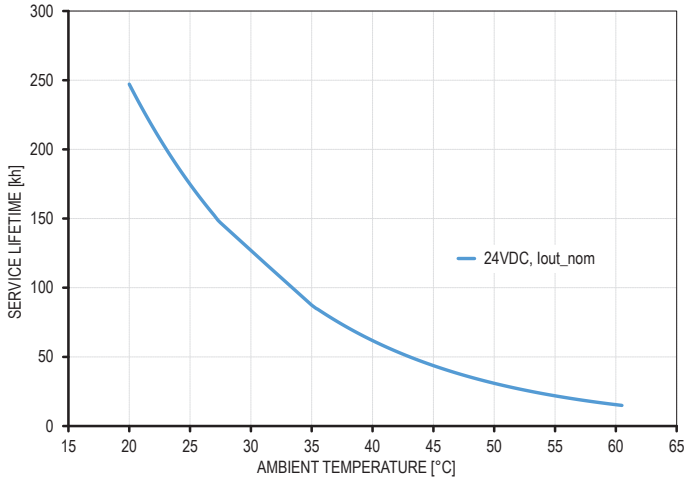


Fig. 12: Expected service lifetime in dependence of ambient temperature

8. Dimensions & Mechanical data

Enclosure material		Aluminum	
Front label material			
-0M model		LEXAN 8010 or equivalent	
-1M model		LEXAN 8B35 or equivalent	
Inflammability class UL94		V0	front labels and terminals
Width		54,0mm ($2^{1}/_{8}$in)	
Height		115,0mm ($4^{17}/_{32}$in)	
Depth		131,2mm ($5^{11}/_{64}$in)	w/o DIN-rail, incl. connectors
Weight			
-0M model		500g (1.10lb)	
-1M model		470g (1.03lb)	
Lever arm	*max.*	54mm ($2^{1}/_{8}$in)	
Torsional moment on DIN-Rail	*max.*	0.26Nm (2.34 lb in)	
Enclosure openings	*max.*	7,0mm ($^{9}/_{32}$in)	
DIN-Rail types IEC/EN 60715		TH 35-7,5, TH 35-15	

Unless otherwise stated, all values are specified in normal mounting position, at full load, nominal input and output voltages, 25°C (77°F) ambient temperature and a run-in time of 5 minutes.

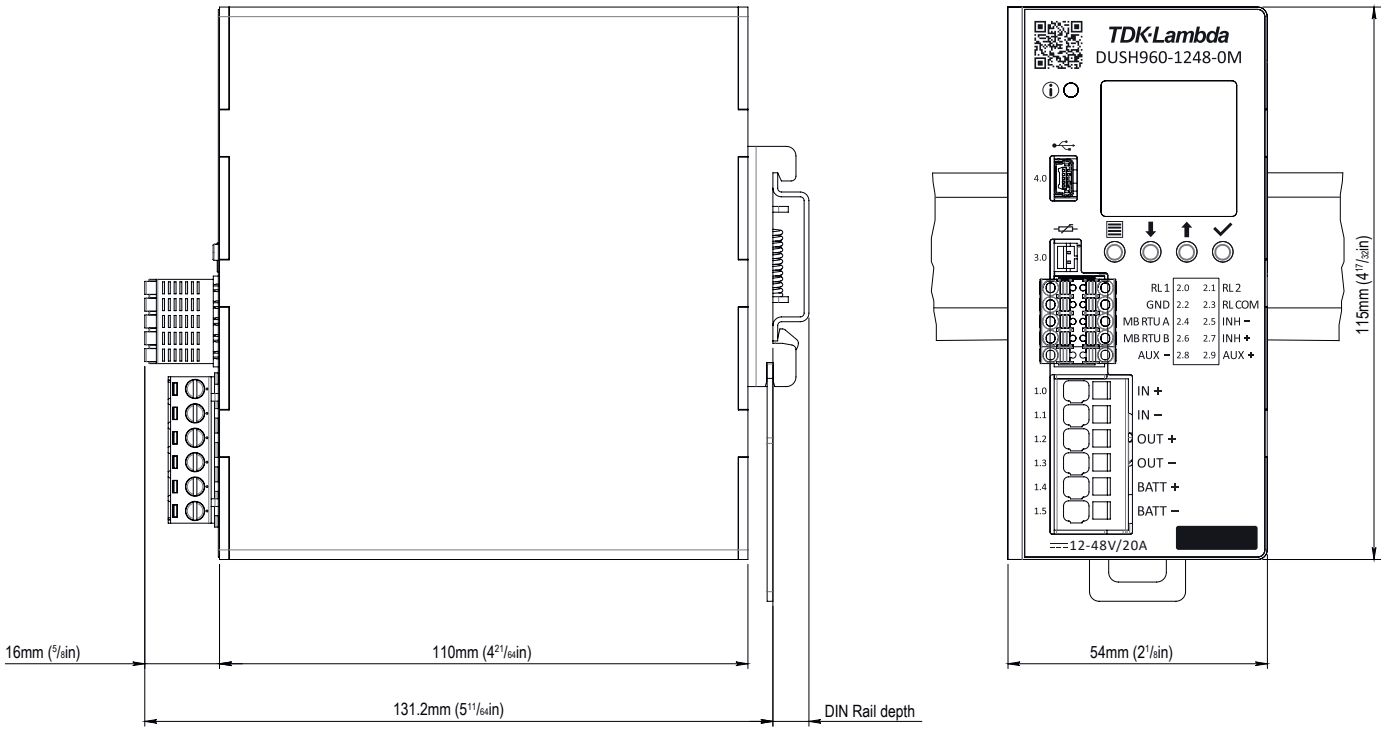


Fig. 13: DUSH960-1248-0M dimensions

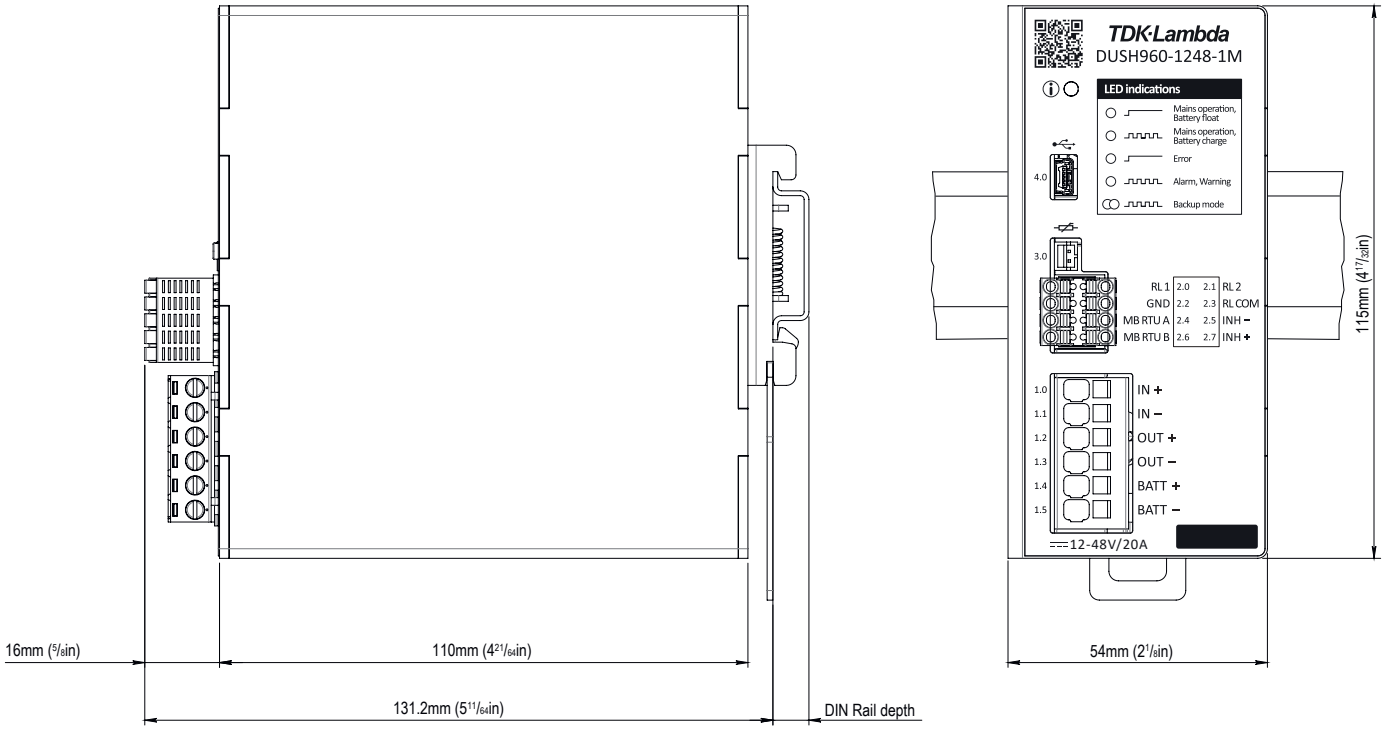


Fig. 14: DUSH960-1248-1M dimensions

9. Communication interfaces

Modbus		
Physical interface		RS485 and USB
Protocol		Modbus/RTU
Topology		Point to point
Baud rate		9600 .. 115200baud
Parity		None, even, odd
Stop bits		1 or 2bit
Transmission distance	*max.*	1000m
Read functions		Device settings, system alarms, status information, log data
Write functions		Device settings, system controls
Electrical isolation		No
Local HMI		
-0M model		
LED colour		Red
LED indication		Alarm
Display		1.5“ colour LCD
Control		4 push buttons
Features		Device settings, system alarms, status information, log data, system controls
-1M model		
LED colour		Red/green
LED indication		Alarm + status
Features		System alarms, status information
Remote HMI		
Software tool		PowerCMC
Functions		Device settings, system alarms, status information, log data, system controls

In order to guarantee the optimal functionality of the DUSH, it is essential to configure the system parameters through one of the following methods: PowerCMC, Modbus, or directly on the device. Otherwise, the DUSH may enter an error state.

10. Installation clearances

Vertically (Z axis)				
Top side	1	*min.*	40mm ($1^{37}/_{64}$in)	
Bottom side	2	*min.*	20mm ($^{25}/_{32}$in)	installation above heat sources not permitted
Horizontally (X axis)				
Left side / Right side	3a 4a	*min.*	15mm ($^{19}/_{32}$in)	to heat sources (same power rating)
Left side / Right side	3b 4b	*min.*	2mm ($^{5}/_{64}$in)	to passive components

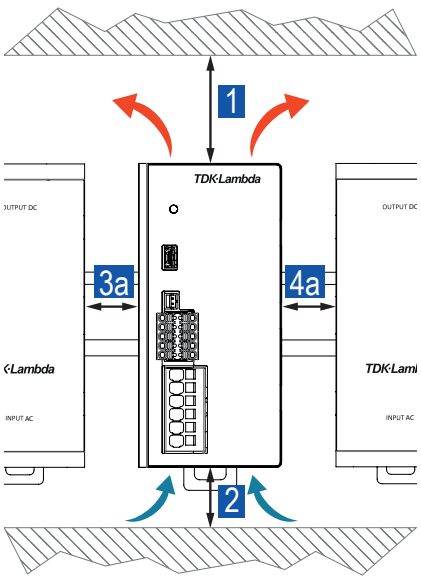


Fig. 15: Installation clearances to heat sources

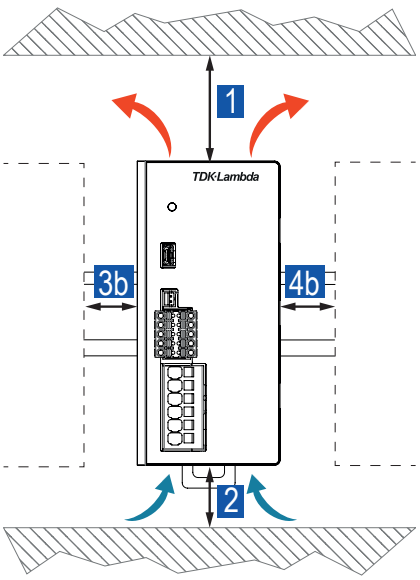


Fig. 16: Installation clearances to passive components

11. Wiring & Connection

	Terminal 1.x	Terminal 2.x	Connector 3.0	Connector 4.0
DUSH960-1248-0M				
Connected functions	Input, Output, Battery	Relays, Modbus, Inhibit. AUX	Temperature sensor	PowerCMC
Terminal type	Push-in	Pluggable push-in (8-pin)	Pluggable (2-pin)	Mini USB
Recommended screw driver	SL 0,6x3,5mm (SL1/32x9/64in)	SL 0,5x3,0mm (SL 1/64x1/8in)		
Solid wire	0,2 .. 4,0mm2 (24 .. 11AWG)	0,2 .. 1,0mm2 (28 .. 16 AWG)		
Flexible wire	0,2 .. 4,0mm2 (24 .. 11AWG)	0,2 .. 1,5mm2 (28 .. 16AWG)		
Standard ferrules*	0,25 .. 2,5mm2	0,25 .. 0,75mm2		
Uninsulated ferrules*	0,25 .. 2,5mm2	0,25 .. 1,0mm2		
Twin ferrules*	0,25 .. 1,5mm2	0,25 .. 1,5mm2		
Stripping length	10 .. 12mm (25/64 .. 15/32)	8 .. 9mm (5/16 .. 23/64)		
DUSH960-1248-1M				
Connected functions	Input, Output, Battery	Relays, Modbus, Inhibit	Temperature sensor	PowerCMC
Terminal type	Push-in	Pluggable push-in (6-pin)	Pluggable (2-pin)	Mini USB
Recommended screw driver	SL 0,6x3,5mm (SL1/32x9/64in)	SL 0,5x3,0mm (SL1/64x1/8in)		
Solid wire	0,2 .. 4,0mm2 (24 .. 11AWG)	0,2 .. 1,0mm2 (28 .. 16 AWG)		
Flexible wire	0,2 .. 4,0mm2 (24 .. 11AWG)	0,2 .. 1,5mm2 (28 .. 16AWG)		
Standard ferrules*	0,25 .. 2,5mm2	0,25 .. 0,75mm2		
Uninsulated ferrules*	0,25 .. 2,5mm2	0,25 .. 1,0mm2		
Twin ferrules*	0,25 .. 1,5mm2	0,25 .. 1,5mm2		
Stripping length	10 .. 12mm (25/64 .. 15/32)	8 .. 9mm (5/16 .. 23/64)		

*The ferrules must be selected to match the stripping length.

ⓘ In compliance to IEC/EN/UL 62368-1 ferrules are required if flexible wires are used. In compliance with IEC/EN/UL 61010-1, 61010-2-201 appropriate copper wires must be used that withstand operating temperatures of at least 75°C (167°F) in ambients NOT exceeding 40°C (104°F), and 90°C (194°F) in ambients exceeding 40°C (104°F).

ⓘ Take into account the current carrying capacity of the cabling according to EN 60204-1 (Safety of machinery - Electrical equipment of machines). To use the full current capacity of the DUSH use either a 4mm² solid wire or a 2.5mm² flexible wire with an adequate temperature rating.

12. Signaling & Control

Alarming			
Type		2 relay contacts	
Characteristic		NO / NC	
Rating		24V_{DC} / 1A	
Resistive load	*nom.*	1A	30V_{DC}
Configuration		via LCD, Modbus or PowerCMC	
Signals		11 status events each relay	
Remote ON/OFF			
Type		Electrical contact	
Chracteristics		Inhibit or enable	
ON/OFF treshold	*max.*	>5V_{DC} ≤0,8	Depending on polarity setting
Restart delay	*max.*	0.5s	
Operating voltage	*max.*	30V_{DC}	
Operating current	*max.*	10mA	
Reference potential		Isolated	
Parallel connection		Yes	
Active discharging		No	

ⓘ In order to guarantee the optimal functionality of the DUSH, it is essential to configure the system parameters through one of the following methods: PowerCMC, Modbus, or directly on the device. Otherwise, the DUSH may enter an error state.

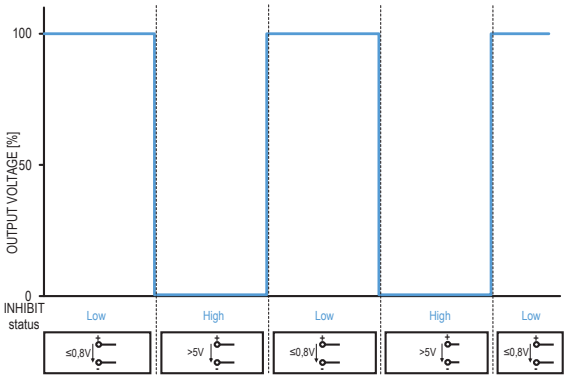


Fig. 17: Control of the output voltage in dependence of the inhibit status with polarity high setting

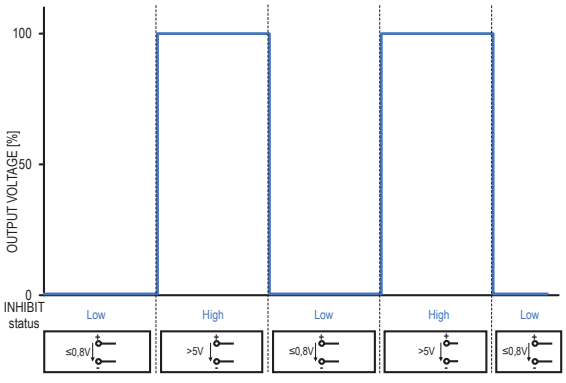
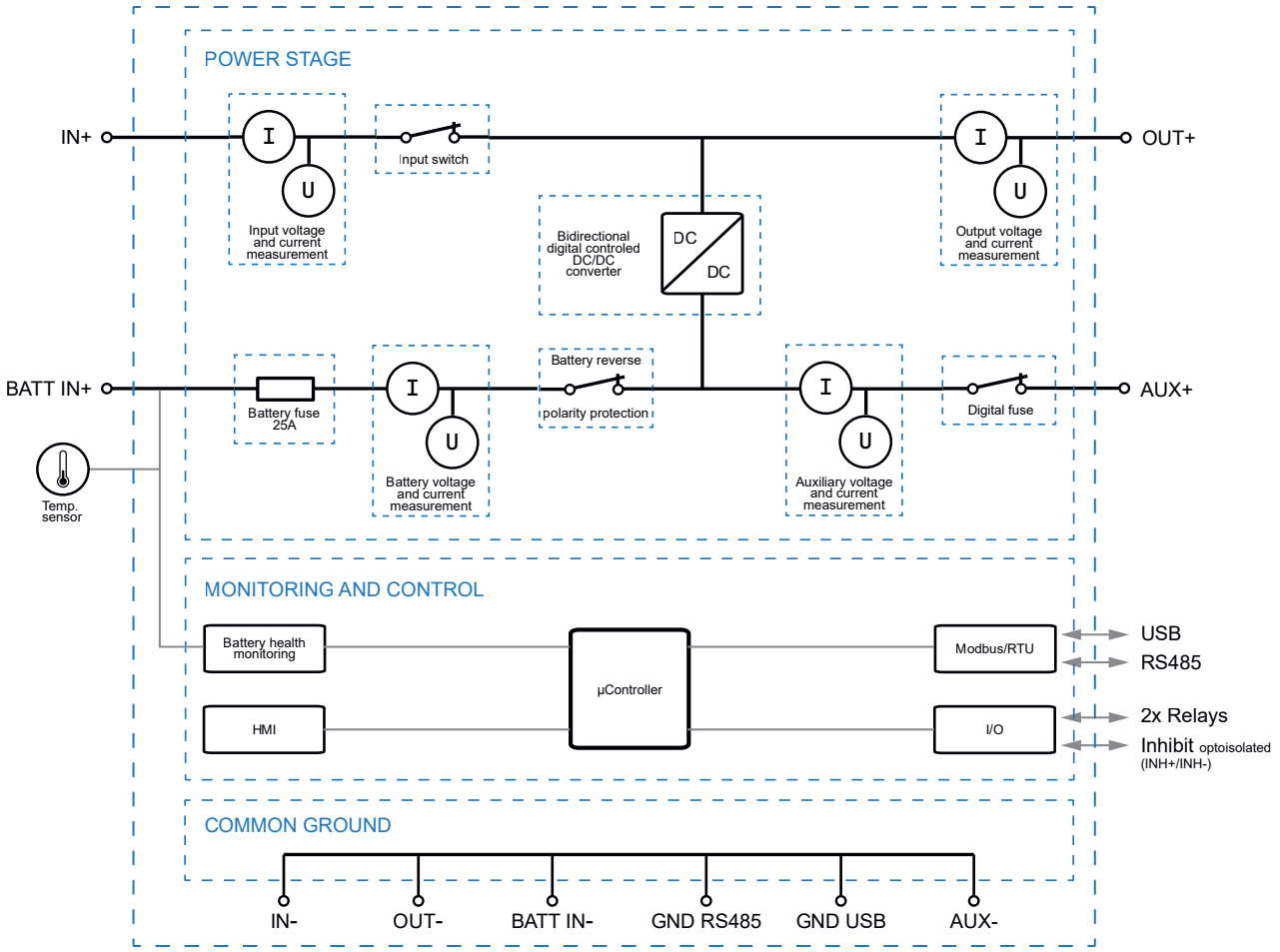


Fig. 18: Control of the output voltage in dependence of the inhibit status with polarity low setting

Unless otherwise stated, all values are specified in normal mounting position, at full load, nominal input and output voltages, 25°C (77°F) ambient temperature and a run-in time of 5 minutes.

13. Block diagram



14. Device protection

Ingress protection degree IEC 60529	IP 20	
NEMA classification NEMA 250-2018	NEMA 1	
Overtemperature protection (OTP)	Yes, auto recovery	
Output overvoltage protection (OVP)		
Normal operation	No	refer to input power supply specification
Backup mode *max.*	62VDC, auto recovery	
Output overcurrent protection (OCP)		
Normal operation	No	refer to input power supply specification
Backup mode *min.*	21A, Hiccup	
Auxilliary output	I²t counter >5A, auto recovery	

It is essential to ensure that a suitably sized DC type circuit breaker is installed on the input, output and battery wiring.

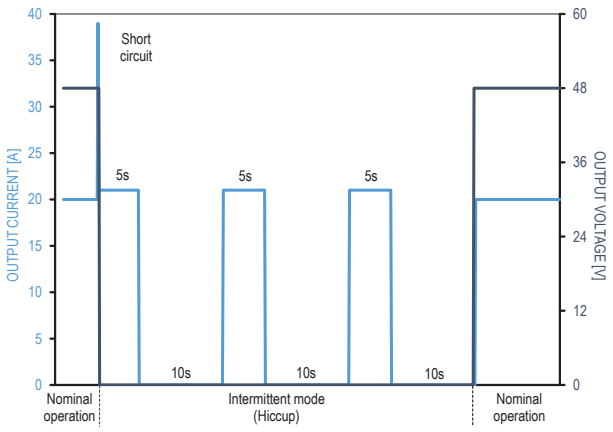


Fig. 19: Output current and voltage in different operation modes

Unless otherwise stated, all values are specified in normal mounting position, at full load, nominal input and output voltages, 25°C (77°F) ambient temperature and a run-in time of 5 minutes.

15. Electrical Safety

Class of protection IEC 61010-1, IEC 62368-1 (Ed.3)	III	
Electrical energy source classification IEC 62368-1 (Ed.3)	ES1	
Safety Extra Low Voltage IEC 61010-2-201	SELV	
Protective Extra Low Voltage IEC 61010-2-201	PELV	
Overvoltage category IEC 61010-1, IEC 62368-1 (Ed.3)	II	<3000mASL (<9842ftASL)

15.1 Insulation strength

		Type test (60s)	Routine test (10s) IEC 61010-1	Field test (3s)
Input / Chassis	A	not applicable, SELV	750V_{DC}	750V_{DC}
Ouput / Chassis	B	not applicable, SELV	750V_{DC}	750V_{DC}
Battery / Chassis	C	not applicable, SELV	750V_{DC}	750V_{DC}

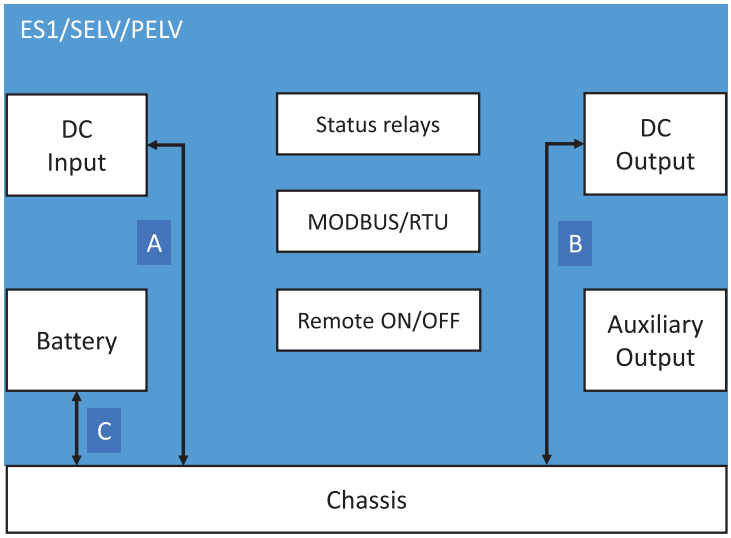


Fig. 20: Schematic of the insulation paths

15.2 HIPOT test

Apart from routine test, the end user might need to check the insulation strength during the final inspection and testing to guarantee the electrical safety of the end application. Therefore, a high-voltage test (HIPOT test) can be performed in the field. The following conditions must be observed:

- As every HIPOT test causes stress on the DUSH safety insulation, avoid frequent HIPOT testing or excessive test voltages.
- The test voltages and durations, as indicated under “Insulation strength” on page 19, must not be exceeded.
- The test voltages rise and fall time should be between 2 and 4 seconds.

ⓘ According to EN 60204-1 (Safety of machinery - Electrical equipment of machines), an individual HIPOT test of the DUSH isn‘t required. During the HIPOT test of the end application, the DUSH can be disconnected and only installed once the test has been completed.

16. Electromagnetic immunity

Investigated under generic standards IEC 61000-6-2:2016 / EN IEC 61000-6-2:2019 / IEC 61000-6-3:2020 / EN IEC 61000-6-3:2021 - Immunity standard for industrial environments and emission standard equipment in residential environments.

Electrostatic contact discharge	4kV	Criterion A	330Ω/150pF
Electrostatic air discharge	8kV	Criterion A	330Ω/150pF
Electromagnetic RF field	10V/m 3V/m	Criterion A Criterion A	80MHz .. 1GHz 1.4GHz .. 2GHz
Fast transients (burst)			
Input	1kV	Criterion A	5kHz
Output	1kV	Criterion A	5kHz
Signal contact	1kV	Criterion A	5kHz
Power frequency magnetic field	30A/m	Criterion A	50Hz, 60s each axis (x, y, z)

ⓘ **Performance level definitions:**

Criterion A:
The device continues operation as intended during and after the test. The specified performance level accepts a change of ±10% on nominal output voltage and current. There is neither a violation of the performance level, nor a loss of function if the device is used as intended.

Criterion B:
The device continues operation as intended after the test. The specified performance level accepts a change of ±10% on nominal output voltage and current. There is neither a violation of the performance level, nor a loss of function if the device is used as intended. During the test a violation of the performance level is allowed.

Criterion C:
A temporary loss of function is allowed, provided the function is auto-recoverable, or can be restored by the operation of the controls.

17. Electromagnetic emission

Investigated under generic standards IEC 61000-6-2:2016 / EN IEC 61000-6-2:2019 / IEC 61000-6-3:2020 / EN IEC 61000-6-3:2021 - Immunity standard for industrial environments and emission standard equipment in residential environments.

Conducted noise emission input EN 55032, CISPR 32	Class B	150kHz .. 30MHz
Radiated noise emission input EN 55032, CISPR 32	Class B	30MHz .. 1GHz

18. Certifications & Approvals

c UL us LISTED	UL 61010-1 CAN/CSA-C22.2 No. 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
	UL 61010-2-201 CAN/CSA-C22.2 No. 61010-2-201	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment UL file: E356563
IECEE CB SCHEME	IEC EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
	IEC EN 61010-2-201	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment
	IEC EN 62368-1 (Ed.3)	Audio/video, information and communication technology equipment - Part 1: Safety requirements
c US	UL 62368-1 (Ed.3)	Audio/video, information and communication technology equipment - Part 1: Safety requirements UL file: E511889

19. Designed to meet

The safety design of the product complies additionally with the following harmonised standards.

IEC 62477-1	Safety requirements for power electronic converter systems and equipment - Part 1: General
IEC 61204-7	Low-voltage switch mode power supplies - Part 7: Safety requirements
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
UL 508	Standard for industrial control equipment

20. Compliance & Registration

CE	Conformity with health, safety, and environmental protection standards for products sold within the European Economic Area (EEA).
UK CA	UKCA (UK Conformity Assessed) is the product marking that is used for certain goods being placed on the United Kingdom market.
	The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community Directive 2012/19/EU on collection, recycling and recovery targets for all types of electrical goods.
RoHS COMPLIANT	The Restriction of Hazardous Substances Directive 2011/65/EU (RoHS 2) regulates the use of certain hazardous substances in electrical and electronic equipment.
ALL COMPONENTS REACH COMPLIANT Registration, Evaluation and Authorisation of Chemicals	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) is a European Union regulation that addresses the production and use of chemical substances, and their potential impacts on both human health and the environment.

21. Application notes

21.1 Parallel operation
It is not permitted to connect the DUSH on the output side in parallel.

21.2 Series operation
It is not permitted to connect the DUSH on the output side in series.

21.3 Battery discharge overview
The diagram shows typical discharge curves in relation to the output current of the DUSH. The original values of the battery manufacturer must be taken into account depending on the respective application. The values shown here are for guidance only.

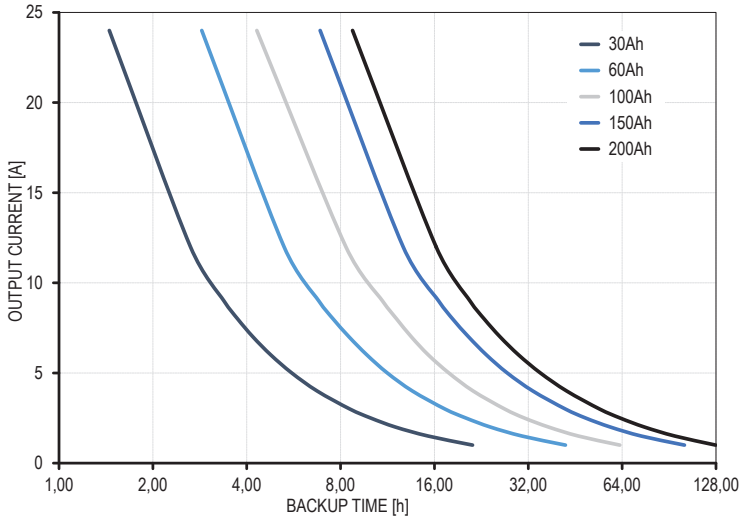


Fig. 21: Backup times in depence of output current for typical lead batteries

TDK·Lambda

TDK-Lambda France SAS
Tel: +33 1 60 12 71 65
tlf.fr-powersolutions@tdk.com
www.emea.lambda.tdk.com/fr

Italy Sales Office
Tel: +39 02 61 29 38 63
tlf.it-powersolutions@tdk.com
www.emea.lambda.tdk.com/it

Netherlands
tlf.nl-powersolutions@tdk.com
www.emea.lambda.tdk.com/nl

TDK-Lambda Germany GmbH
Tel: +49 7841 666 0
tlg.powersolutions@tdk.com
www.emea.lambda.tdk.com/de

Austria Sales Office
Tel: +43 2256 655 84
tlg.at-powersolutions@tdk.com
www.emea.lambda.tdk.com/at

Switzerland Sales Office
Tel: +41 44 850 53 53
tlg.ch-powersolutions@tdk.com
www.emea.lambda.tdk.com/ch

Nordic Sales Office
Tel: +45 8853 8086
tlg.dk-powersolutions@tdk.com
www.emea.lambda.tdk.com/dk

TDK-Lambda UK Ltd.
Tel: +44 (0) 12 71 85 66 66
tlu.powersolutions@tdk.com
www.emea.lambda.tdk.com/uk

TDK-Lambda Ltd.
Tel: +9 723 902 4333
tli.powersolutions@tdk.com
www.emea.lambda.tdk.com/il-en

TDK-Lambda Americas
Tel: +1 800-LAMBDA-4 or 1-800-526-2324
tla.powersolutions@tdk.com
www.us.lambda.tdk.com

TDK Electronics do Brasil Ltda
Tel: +55 11 3289-9599
sales.br@tdk-electronics.tdk.com
www.tdk-electronics.tdk.com/en

TDK-Lambda Corporation
Tel: +81-3-6778-1113
www.jp.lambda.tdk.com

TDK-Lambda (China) Electronics Co. Ltd.
Tel: +86 21 6485-0777
tlc.powersolutions@tdk.com
www.lambda.tdk.com.cn

TDK-Lambda Singapore Pte Ltd.
Tel: +65 6251 7211
tls.marketing@tdk.com
www.sg.lambda.tdk.com

TDK India Private Limited, Power Supply Division
Tel: +91 80 4039-0660
mathew.philip@tdk.com
www.sg.lambda.tdk.com

For further information please visit:
emea.lambda.tdk.com/dush-series