Premium
Powering Your Challenge

CLS-150

150W / ULTRA-WIDE INPUT 24V-110V

GENERAL FEATURES

- Fully EN50155 compliant, no external circuits
- Ultra-wide input range 11:1 reduces product variety
- Excellent efficiency, lowest power loss, full lifetime
- Full power up to +85° without heat sink, no derating
- Active input reverse polarity protection
- Active inrush current limitation-network protection
- 10ms hold-up time over the entire input range
- Reinforced insulation, 6mm air/creepage distances
- Trim-output for long cable runs or battery charging
- Parallel and redundant operation
- 10% Peak load capability for 10s
- Remote (on/off) and DC OK with relay changer
- 2 years warranty



Dimensions (LxWxH): 188.6 x 116.0 x 42.5mm
(7.42 x 4.57 x 1.67 inch) 700g (1.54 lbs)

SAFETY & EMC

CE UKCA ROHS REACH

APPLICATIONS



DESCRIPTION

The chassis mountable CLS-150-UW series DC/DC converter is designed for railway and transportation applications and is compliant with all relevant standards: EN50155, EN50121-3-2, DB-EMV06, EN50124-1, EN50125-1, EN61373 1B, EN62368-1, EN45545-2. The unit is designed with 11:1 input voltage range to cover the input voltages from 14.4VDC up to 154VDC for nominal 24, 36, 48, 72 and 110V in one range for all applications - on every vehicle worldwide. The isolated and regulated 24V output works with a reinforced isolation system. Due to the base plate mounting the unit operates with full power within the wide temperature for OT4+ST1&ST2 class from -40°C to +85°C and no additional cooling systems are necessary. Input reverse polarity protection, inrush current limitation, 10ms hold-up time, remote control, and output OR-ing diode and efficiency of up to 94% round up the functionality of this fully railway compliant Plug&Play unit.

SELECTION GUIDE

Part Number	Input Voltage Range [VDC]	Output Voltage nom. [VDC]	Output Current max. (1) [A]	Efficiency typ. [%]	Output Power max. (1) [W]
CLS-150-36517	16.8-137.5	24	6.88	94	165
CLS-150-36517-L	16.8-137.5	24	6.88	94	165
CLS-150-36522	16.8-137.5	15	10	94	150
CLS-150-36523	16.8-137.5	±15	5	94	TBD

Note1: Refer to "Peak load Capability"

MODEL NUMBERING

CLS-150-36517

Nominal Power — Model number

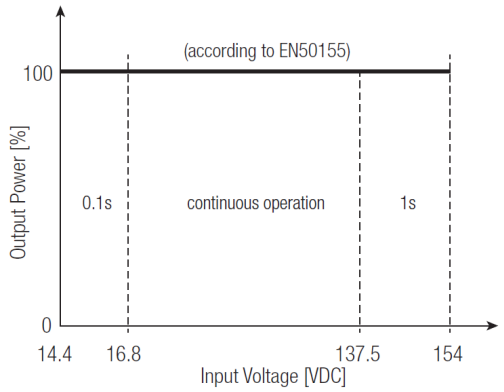
Note2: add suffix "-L" for extended ambient temperature range (-50°C..+90°C) *coming soon without suffix= standard operating range (-40°C..+90°C)

Specifications are subject to change without notice. These products are not intended for use as critical components in life support or nuclear systems.

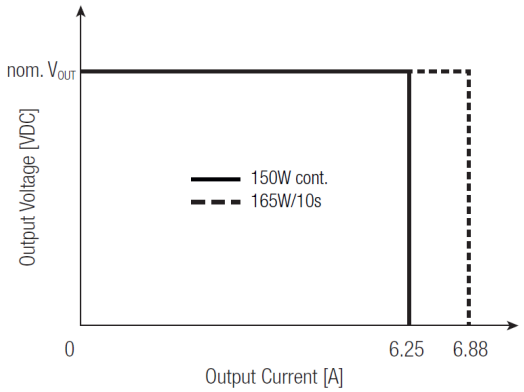
BASIC CHARACTERISTICS (measured @ T_{amb} = 25°C, nom. V_{in}, full load and after warm-up unless otherwise stated)

Parameter	Conditions			Min.	Typ.	Max.
Input Voltage Range	refer to "Input Voltage Range"	nom. V_{IN}= 24, 36, 48, 72, 110V_{dc}		16.8V_{dc}		137.5V_{dc}
		according to EN 50155	100ms max	14.4V_{dc}		16.8V_{dc}
			1s max.	137.5V_{dc}		154V_{dc}
Input Capacitance	internal				440µF	
Under Voltage Lockout	rising edge			14.5VDC		15.5V_{dc}
	falling edge			13.5VDC		14.4V_{dc}
Input Current	V_{in}=16.8V_{dc}			9.9A		6.1
	V_{in}= 24V_{dc}			6.7A		4.2A
	V_{in}= 110V_{dc}			1.4A		
Inrush Current	active inrush current limitation (<3.5 x Inom)					21.8A
No Load Power Consumption	V_{in}= 24V_{dc}				3.1W	
	V_{in}= 110V_{dc}				4.1W	
Standby Power (shutdown by remote)	V_{in}=16.8V_{dc}				38.7mA	
	V_{in}= 24V_{dc}				26.3mA	
	V_{in}= 110V_{dc}				10.7mA	
	V_{in}= 137.5V_{dc}				10.6mA	
Output Current Range	continuous operation			0A		6.25A
	10s max., refer to "Peak load Capability"					6.88A
Output Voltage					24V_{dc}	
Output Voltage Trimming				19.2V_{dc}		25.2V_{dc}
Minimum Load				0%		
Start-up time	V_{in}= 24V_{dc}					600ms
	V_{in}= 110V_{dc}					300ms
	by using CTRL ON/OFF function					300ms
Rise time	V_{in}= 24V_{dc}					100ms
Hold-up time	V_{in}= 24V_{dc}			10ms	10ms	
	V_{in}= 72/110V_{dc}				20ms	
ON/OFF CTRL	DC-DC ON			high/open or 12V_{dc} < V_{ctrl} <154V_{dc}		
	DC-DC OFF (pin13 INH connected pin14 INH0)			low or -2V_{dc} < V_{ctrl}< 2V_{dc}		
Input Current of CTRL pin	DC-DC ON					10mA
Internal Operating Frequency					70kHz	
Output Ripple and Noise	over full input and load range, 20MHz BW					80mVp-p
Maximum Capacitive Load	constant current mode				50mF	

Input Voltage Range

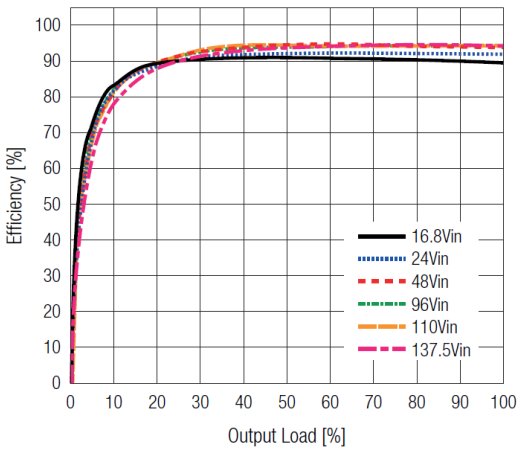


Constant Current / Constant Voltage

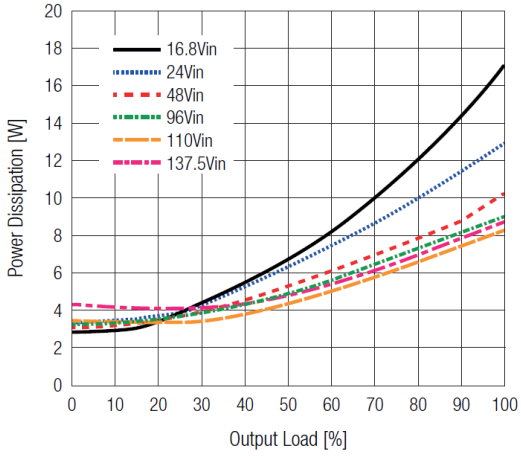


BASIC CHARACTERISTICS (measured @ T_{amb} = 25°C, nom. V_{in}, full load and after warm-up unless otherwise stated)

Efficiency vs Load



Power Dissipation vs Load



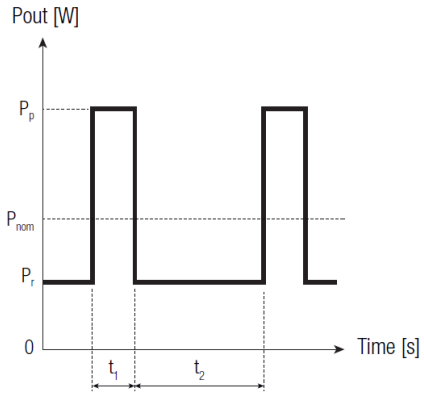
PEAK LOAD CAPABILITY

Peak power capability supports short power peaks of dynamic loads like motors, relays, storage devices or computer booting sequences. In addition allowing faster charge of load sided capacitors and reliable circuit breaker operation.

P_{nom}	= nominal output power	[W]
P_p	= peak output power (165W max)	[W]
P_r	= recovery power	[W]
t_1	= peak time (10s max)	[s]
t_2	= recovery time (calculated)	[s]

Calculation:

$$t_2 = \frac{(P_{nom} - P_P) \times t_1}{P_r - P_{nom}}$$



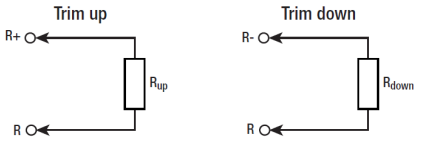
Practical Example:

P_{nom} = 150W
P_p = 165W
P_r = 145W
t_1 = 10s

$$t_2 = \frac{(150W - 165W) \times 10s}{145W - 150W} = \underline{30s}$$

OUTPUT VOLTAGE TRIMMING

The output voltage of the CLS-150 can be trimmed between +5% and -20% by using an external trim resistor. The values for the trim resistor are according to standard E96 values; therefore, the specified voltage may slightly vary. Resistor values may be calculated with the following equation:



Calculations:

$Vout_{nom}$ = nominal output voltage [VDC]
$Vout_{set}$ = trimmed output voltage [VDC]
R_{up} = trim up resistor [Ω]
R_{down} = trim down resistor [Ω]

$$R_{up} \cong \frac{322k\Omega \times V_{OUTnom} - 306k\Omega \times V_{OUTset}}{V_{OUTset} - V_{OUTnom}}$$

$$R_{down} \cong \frac{20k\Omega \times V_{OUTset} - 16k\Omega \times V_{OUTnom}}{V_{OUTnom} - V_{OUTset}}$$

OUTPUT VOLTAGE TRIMMING

Practical Example trim up +5% for CLS-150-6517

$$R_{up} = \left[\frac{322k\Omega \text{ x } 24V - 306k\Omega \text{ x } 25.2V}{25.2V - 24V}\right] = 14000\Omega$$

R_{up} according to E96 ≈ **14kΩ**

Practical Example trim down -10% for CLS-150-6517

$$R_{down} = \left[\frac{20k\Omega \text{ x } 21.6V - 16k\Omega \text{ x } 24V}{24V - 21.6V}\right] = 20000\Omega$$

R_{down} according to E96 ≈ **20kΩ**

CLS-150-6517

Trim up	1	2	3	4	5	[%]
$Vout_{set}$ =	24.24	24.48	24.72	24.96	25.2	[V_{dc}]
R_{up} (E96) ≈	1M3	499k	226k	93k1	14k	[Ω]

Trim down	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	[%]
$Vout_{set}$ =	23.76	23.52	23.28	23.04	22.8	22.56	22.32	22.08	21.84	21.6	[V_{dc}]
R_{down} (E96) ≈	383k	182k	113k	80k6	60k4	46k4	37k4	30k1	24k3	20k	[Ω]

Trim down	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	[%]
$Vout_{set}$ =	21.36	21.12	20.88	20.64	20.4	20.16	19.92	19.68	19.44	19.2	[V_{dc}]
R_{down} (E96) ≈	16k2	13k3	10k7	8k45	6k65	4k99	3k48	2k21	1k05	0	[Ω]

REGULATIONS

Parameter	Conditions	Value
Output Accuracy		±1.0% max.
Line Regulation	low line to high line, full load	±0.1% max.
Load Regulation	10%-100% load	0.2% typ.
Transient Response	10-90% load, VIN= 16.8-137VDC	0.5VDC
	recovery time	40ms typ.

PROTECTIONS (measured @ T_{amb} = 25°C, nom. V_{in}, full load and after warm-up unless otherwise stated)

Parameter	Type			Value
Internal Input Fuse				T15A, slow blow type
Short Circuit Protection (SCP)	constant current mode, auto recovery			>110%-125% of nom. output current
Short Circuit Input Current	V_{in}= 24V_{dc}			0.8A
	V_{in}= 110VV_{dc}			0.4A
Input Reverse Polarity Protection	active protected			-137.5V_{dc}
Over Voltage Protection (OVP)	latch off			28.8V_{dc} - 32.4V_{dc}
Over Voltage Category (OVC)	according to EN 50124-1:2018			OVC III
Over Current Protection (OCP)	auto recovery			>110%-125% of nom. output current
Over Temperature Protection (OTP)	auto recovery			105°C internal
Class of Equipment				Class I
Isolation Coordination	according to EN 50124-1:2018			V_{nom}= 300V_{dc}
Isolation Voltage (2)	DC tested / AC rated	I/P to O/P		5kVDC / 3.5kV_{ac}
		I/P to PE and O/P to PE		3kVDC / 2kV_{ac}
	routine test	I/P to O/P, 10 seconds		2.8kV_{dc}
		for 10 seconds on safety components	I/P to O/P	3kV_{dc}
			I/P to PE and O/P to PE	2.8kV_{out}
Isolation Resistance				100MΩ min.
Isolation Capacitance				650pF max.
Leakage Current				10µA max.
Insulation Grade				reinforced
Internal Clearance	I/P to O/P			6mm
	I/P to PE			4mm
	O/P to PE			3mm

POWER GOOD

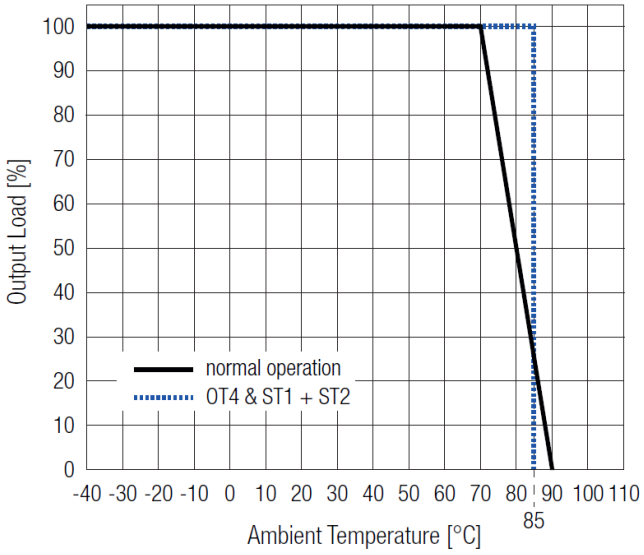
Parameter	Type	Value
Power OK LED	V_{out}= >17V_{dc}	green
	V_{out}= <17V_{dc}	light off
Relay Status	V_{out}= >17V_{dc}	OK: OK1 connected OK or OK2 not connected OK
	V_{out}= <17V_{dc}	NOK: OK2 connected OK or OK1 not connected OK
Relay Capability		0.5A/150VDC

ENVIRONMENTAL (measured @ T_{amb} = 25°C, nom. V_{in}, full load and after warm-up unless otherwise stated)

Parameter	Conditions		Value
Operating Ambient Temperature Range		with derating	-40°C to +90°C
		without derating	-40°C to +70°C
	according to EN 50155 operating temperature class OT4 and extended operating temperature class ST1 & ST2	without derating for 15 minutes	-40°C to +85°C
Maximum Baseplate Temperature			+95°C
Temperature Coefficient			0.2%/K
Operating Altitude	according to EN 50124-1:2018		2000m (OVC III)
			5000m (OVC II)
Operating Humidity	non-condensing		95% RH max.
Conformal Coating (4)	according to EN 50155		Class PC2
Pollution Degree			PD2
IP Rating			IP20
Design Lifetime			20 years
MTBF	according to IEC 61709/ UTE C80-810	T_{amb}= +40°C	1950 x 10³ hours
		T_{amb}= +50°C	1400 x 10³ hours
Useful Life Class	according to EN50155:2018 (S1)		L4

Note4: The board is protected on both sides with a protective / transparent / fluorescent / coating. The coating is compliant with class 2, according to IPC-A-610G: 2017

DERATING GRAPH



ENVIRONMENTAL (Railway Standards)

Parameter	Conditions	Value
Low Temperature start-up test	Temperature: -40°C Stabilization time: 2h	EN 60068-2-1 (Ad)
Dry heat test	Temperature: +70°C Continuous operational checks time: 6h	EN 60068-2-2 (Be) – Cycle A
Low temperature storage test	Temperature: -40°C Low temperature exposition time: 16h	EN 60068-2-1 (Ab)
Cyclic damp heat test	Temperature: +70°C/+25°C Number of cycles: 2 Time: 2x 24h	EN 60068-2-30 (Db)
Simulated long-life testing (Test performed at maximum level for each axis.)	Random Vibration, unit not powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Vertical axis 5.72m/s² for 5h [ASD 0.964(m/s²)²/Hz] Transverse axis 2.55m/s² for 5h [ASD 0.192(m/s²)²/Hz] Longitudinal axis 3.96m/s² for 5h [ASD 0.461(m/s²)²/Hz]	EN 61373 clause 9, class B Body mounted
Shock testing (Test performed at maximum level for each axis.)	Half-sine shock, unit powered during test Vertical axis 30m/s² for 30ms Transverse axis 30m/s² for 30ms Longitudinal axis 50m/s² for 50ms Number of shocks: 18 (3x polarity for each axis)	EN 61373 clause 10, class B Body mounted
Functional random vibration test (Test performed at maximum level for each axis.)	Random Vibration, unit powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Vertical axis 1.01m/s² for 10min [ASD 0.0301(m/s²)²/Hz] Transverse axis 0.45m/s² 10min [ASD 0.006(m/s²)²/Hz] Longitudinal axis 0.7m/s² 10min [ASD 0.0144(m/s²)²/Hz]	EN 61373 clause 8, class B Body mounted
Fire Protection on Railway Vehicles		EN45545-2 Hazard Level HL1 - HL3

SAFETY & CERTIFICATIONS

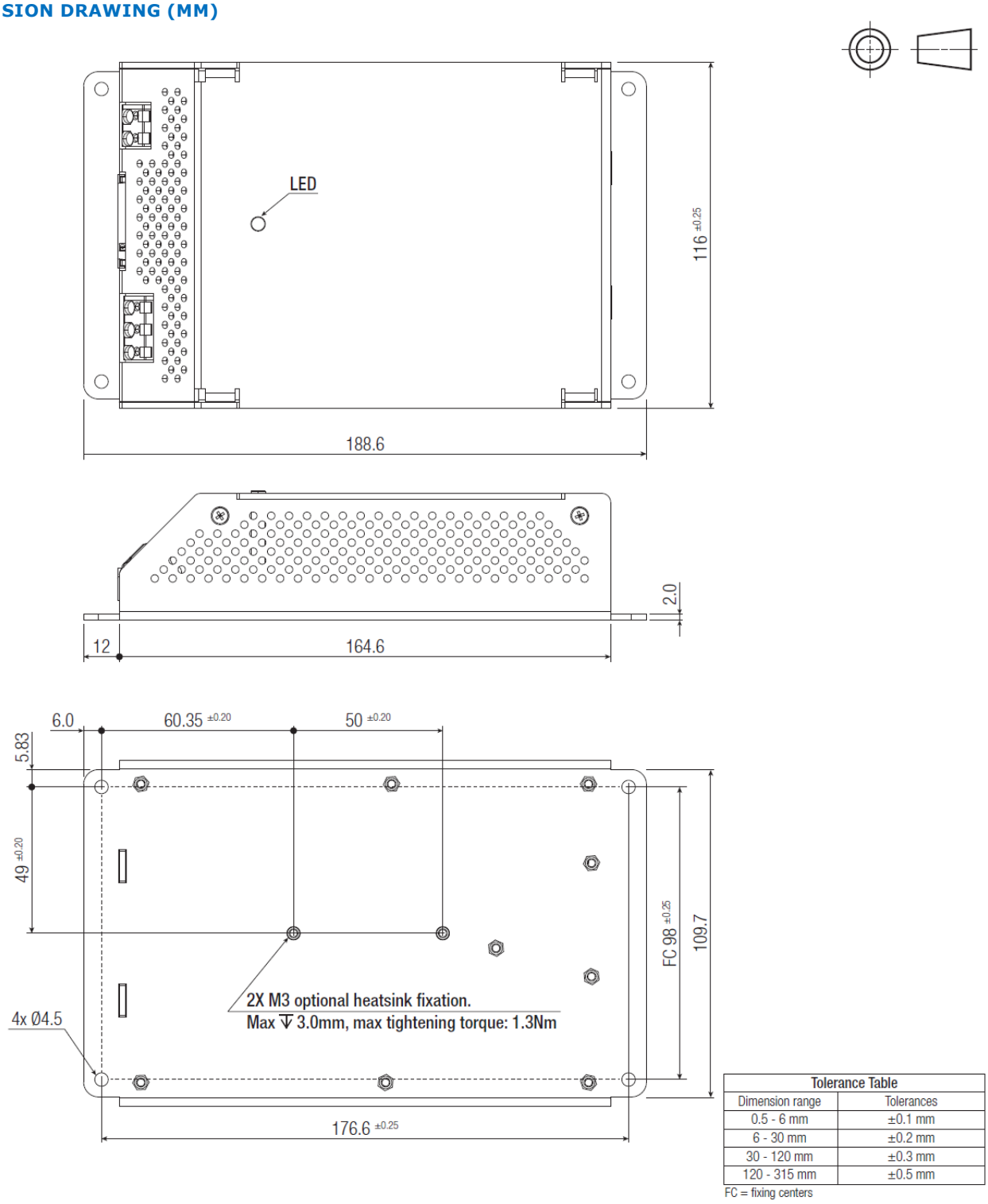
Certificate Type (Safety)	Standard
Audio/Video, information and communication technology equipment - Part1: Safety requirements 3rd Edition	IEC62368-1:2018 3rd Edition EN IEC 62368-1:2020+A11:2020
Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment	EN50124-1:2017
Railway Applications - Electrical Equipment used on rolling stock	EN50155:2017
RoHS2	RoHS 2011/65/EU + AM2015/863

EMC Compliance	Conditions		Standard / Criterion
Railway applications - Electromagnetic compatibility			EN50121-3-2:2016+A1:2019
Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments			EN61000-6-4:2007+A1:2011
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8kV Contact: ±2, 4, 6kV		IEC61000-4-2:2009, Criteria A EN61000-4-2:2008, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	20V/m (80-1000MHz) 10V/m (1000-2000MHz)		IEC/EN61000-4-3:2006, Criteria A
Fast Transient and Burst Immunity	DC Power Port: ±2kV		IEC/EN61000-4-4:2012, Criteria A
Surge Immunity	DC Power Port: ±0.5, 1kV line sym. DC Power Port: ±0.5, 1, 2kV line unsym.		IEC/EN61000-4-5:2014, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10Vr.m.s. (0.15-80MHz)		IEC/EN61000-4-6: 2016, Criteria A
Operational Behaviour, Voltage Fluctuations and Interruptions	Operational behavior	0.7 UN and 1.25 UN for 1min	IEC61000-4-29:2000 EN61000-4-29:2000
	Voltage fluctuation	UN -> 0.6 UN and UN -> 1.4 UN for 0.1s (10 times)	
		1.25 UN -> 1.4 UN for 1.0s (10 times)	
	Short interruption of mains voltage	at UN fo 10ms (10 times)	
Railway applications - Electromagnetic compatibility			EN50121-3-2:2016+A1:2019
Technical rules for electromagnetic compatibility: Proof of radio compatibility of rail vehicles with railway radio services			Regelung Nr. EMV 06:2019

DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	aluminum
Dimension (LxWxH)		188.6 x 116.0 x 42.5mm 7.42 x 4.57 x 1.67 inch
Weight		700g typ. 1.54 lbs

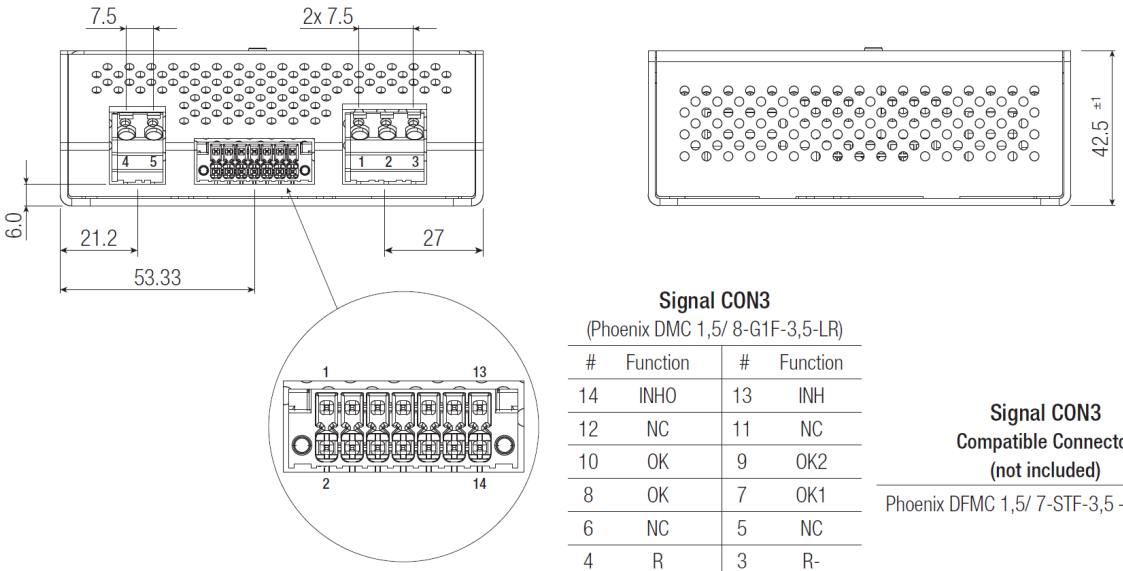
DIMENSION DRAWING (MM)



Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

FC = fixing centers

DIMENSION & PHYSICAL CHARACTERISTICS



Signal CON3
(Phoenix DMC 1,5/ 8-G1F-3,5-LR)

#	Function	#	Function
14	INHO	13	INH
12	NC	11	NC
10	OK	9	OK2
8	OK	7	OK1
6	NC	5	NC
4	R	3	R-
2	R	1	R+

Signal CON3
Compatible Connector
(not included)

Phoenix DFMC 1,5/ 7-STF-3,5 – 1790344

Input connector CAGE CLAMP® CON1
(WAGO 745-3153)

#	Function	AWG	Wire diameter
1	-Vin	28-12	0.08-4mm²
2	+Vin	28-12	0.08-4mm²
3	PE	28-12	0.08-4mm²

wire stripping length: 8-9mm
Conductor connection direction to PCB 45°

Output connector CAGE CLAMP® CON2
(WAGO 745-3152)

#	Function	AWG	Wire diameter
4	+Vout	28-12	0.08-4mm²
5	-Vout	28-12	0.08-4mm²

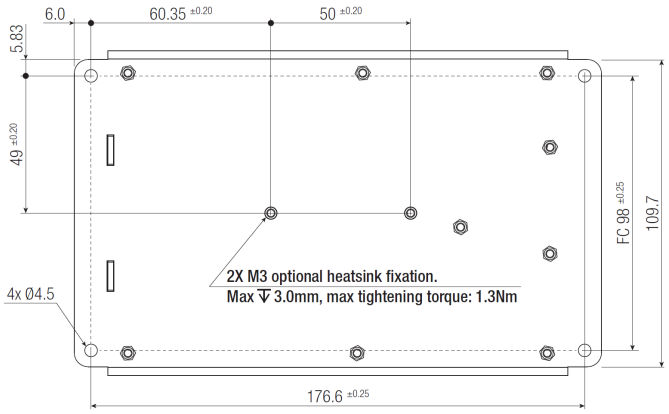
wire stripping length: 8-9mm
Conductor connection direction to PCB: 45°

Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

FC = fixing centers

INSTALLATION & APPLICATION

MOUNTING INSTRUCTIONS



For operation of the DC/DC converter the PE connection at the intended connection point as part of the overall EMC concept is mandatory.

Natural air convection around the unit must be possible at any time and the temperature shall not be exceeded.

The converter has to be installed with 4 x M4 screws and can be mounted in any mounting direction.

All control and signal terminals have been tested and have passed the requirements according to the EN50121-3-2 regulations, nevertheless for installation conditions with cable lengths above 30m, maybe additional protection against disturbances will be necessary.

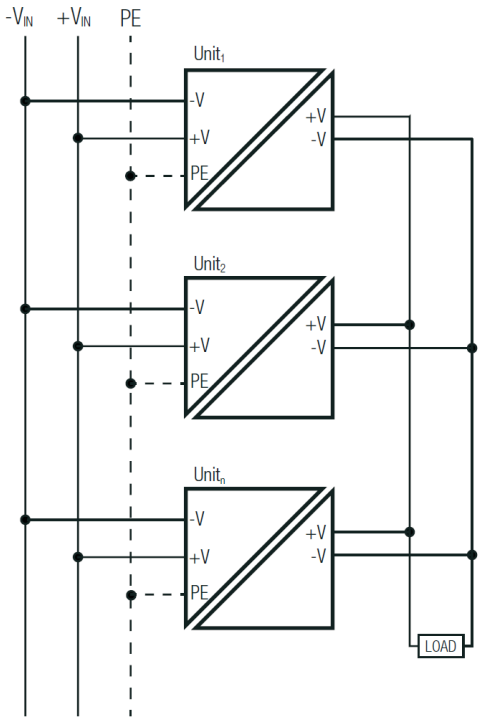
ACCESORIES

Accesories	Notes	Order qty. / device	CODE
Signals mating connector	DEGSON 15EDGKNG-3.5-XXP-1Y-1000A(H)	1	2601-1119

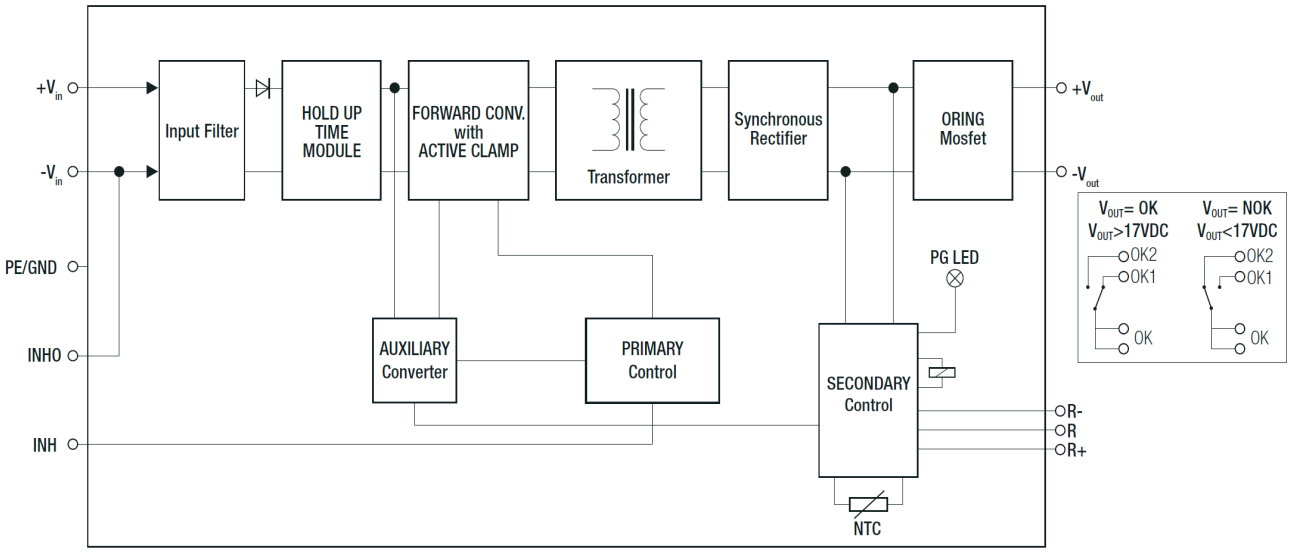
INSTALLATION & APPLICATION

PARALLEL OPERATION

Here the example of three parallel connected units.



BLOCK DIAGRAM



PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	cardboard box	125.0 x 48.0 x 198.0mm
Packaging Quantity		1pc
Storage Temperature Range		-40°C to +85°C