Premium
Powering Your Challenge

CLS-300

300W / ULTRA-WIDE INPUT 24V-110V

GENERAL FEATURES

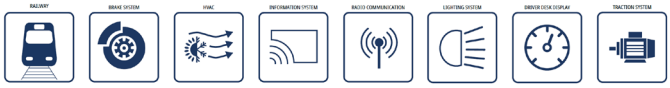
- Fully EN50155 compliant, no external circuits
- Ultra-wide input range 12:1 reduces product variety
- Excellent efficiency, lowest power loss, full lifetime
- Full power up to +85° without heat sink, no derating
- Active input reverse polarity protection
- Active inrush current limitation - network 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): 209.0 x 141.0 x 48.0mm
(8.23 x 5.55 x 1.89 inch) 1100g (2.43 lbs)

SAFETY & EMC

CE UKCA ROHS REACH

APPLICATIONS



DESCRIPTION

The chassis mountable CLS-300 series DC/DC converter is designed for railway rolling stock 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 12:1 input voltage range to cover the input voltages from 14.4V_{dc} up to 170V_{dc} for nominal 24, 36, 48, 72 and 110V in one range with isolated and regulated 24V output and reinforced isolation system. The base plate mounting permits a wide operating temperature for OT4+ST1&ST2 class from -40°C to +85°C without derating. Input reverse polarity protection, inrush current limitation, 10ms hold-up time, remote control, and output OR-ing diode and efficiency of up to 94.8% 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-300-36518	16.8-137.5	24	13.75	94	330
CLS-300-6519 *coming soon*	16.8-137.5	24	13.75	94	330
CLS-300-36519L	16.8-137.5	110	-	94	330
CLS-300-36520	16.8-137.5	110	-	94	330

Note1: Refer to "Peak Load Capability"

MODEL NUMBERING

CLS-300-36518

Nominal Power — Model Number

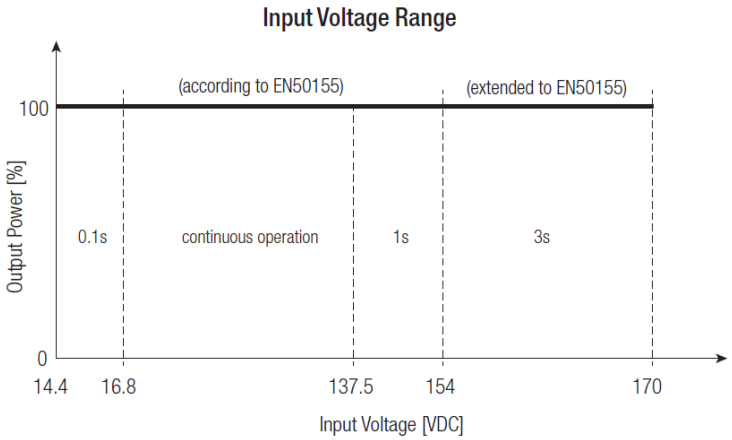
Note2: add suffix "-E" for extended ambient temperature range (-50°C..+90°C) *coming soon
without suffix= standard operating range (-40°C..+90°C)

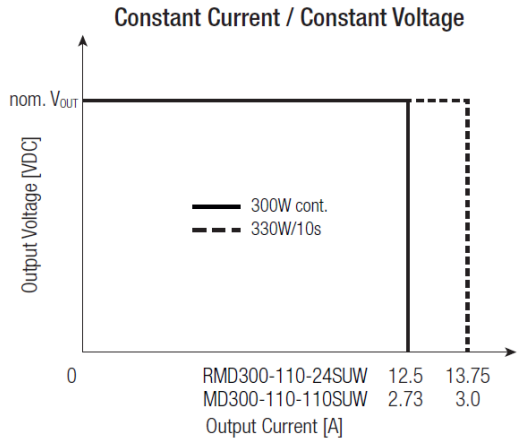
BASIC CHARACTERISTICS (measured @ T_{amb} = 25°C, nom. V_{in}, full load and after warm-up unless otherwise stated)

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 Surge Voltage	3s max. (extended to EN 50155)					170V_{dc}
Input Capacitance	internal				11µF	
Under Voltage Lockout	rising edge			14.5V_{dc}		15.5V_{dc}
	falling edge			13.5V_{dc}		14.4V_{dc}
Input Current	V_{in}=16.8V_{dc}				19.8A	
	V_{in}= 24V_{dc}				13.6A	
	V_{in}= 110V_{dc}				2.9A	
Inrush Current	active inrush current limitation (<3.5 x Inom)					30A
No Load Power Consumption	V_{in}= 24V_{dc}				7.1W	
	V_{in}= 110V_{dc}				7.3W	
Standby Power (shutdown by remote)	V_{in}=16.8V_{dc}				21.4mA	
	V_{in}= 24V_{dc}				14.8mA	
	V_{in}= 110V_{dc}				7.2mA	
	V_{in}= 137.5V_{dc}				7mA	
Output Current Range	CLS-300-6518	continuous operation		0A		12.5A
		10s max. refer to "Peak Load Capability"				13.75A
	CLS-300-6519	continuous operation				2.73A
		10s max. refer to "Peak Load Capability"				3A
Output Voltage	CLS-300-6518				24V_{dc}	
	CLS-300-6519				110V_{dc}	
Output Voltage Trimming	refer to "Output Voltage Trimming"	CLS-300-6518		19.2V_{dc}		25.2V_{dc}
		CLS-300-6519		88V_{dc}		115.5V_{dc}
Minimum Load				0%		
Start-up time	V_{in}= 24V_{dc}					1s
	V_{in}= 110V_{dc}					0.6s
	by using CTRL ON/OFF function					0.3s
Rise time						100ms
Hold-up time	V_{in}=16.8V_{dc}				10ms	
	V_{in}= 24V_{dc}				20ms	
	V_{in}= 110V_{dc}				20ms	

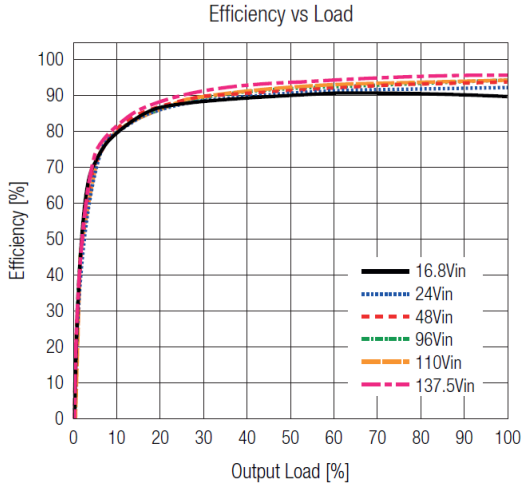
Parameter	Conditions	Min.	Typ.	Max.
ON/OFF CTRL	DC-DC ON	high/open or $12V_{dc} < V_{CTRL} < 154V_{dc}$		
	DC-DC OFF (pin15 INH connected pin16 INH0)	low or $-2V_{dc} < V_{CTRL} < 2V_{dc}$		
Input Current of CTRL pin	DC-DC ON			10mA
Internal Operating Frequency			70kHz	
Output Ripple and Noise	over full input and load range, 20MHz BW			50mVp-p
Maximum Capacitive Load	constant current mode		50mF	

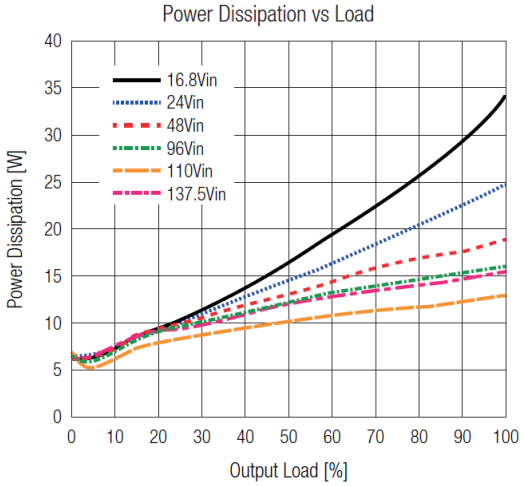
BASIC CHARACTERISTICS (measured @ T_{amb} = 25°C, nom. V_{in} , full load and after warm-up unless otherwise stated)





CLS-300-6518





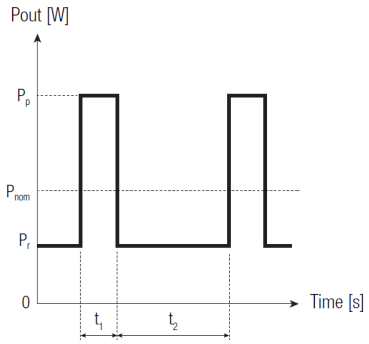
PEAK LOAD CAPABILITY

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 (330W max)	[W]
P_r	= recovery power	[W]
t_1	= peak time (10s max)	[s]
t_2	= recovery time (calculated)	[s]

Calculation:

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



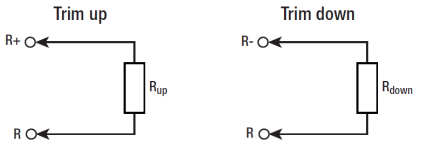
Practical Example:

P_{nom} = 300W
P_p = 330W
P_r = 280W
t_1 = 10s

$$t_2 = \frac{(300W - 330W) \times 10s}{280W - 300W} = \underline{15s}$$

OUTPUT VOLTAGE TRIMMING

The output voltage of the CLS-300 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]

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

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

Practical Example trim up +5% for CLS-300-6518

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

R_{up} according to E96 ≈ 14kΩ

Practical Example trim down -10% for CLS-300-6519

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

R_{down} according to E96 ≈ 20kΩ

CLS-300-6518

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]

CLS-300-6519

Trim up	1	2	3	4	5	[%]
$Vout_{set}$ =	111.1	112.2	113.3	114.4	115.5	[V_{dc}]
R_{up} (E96) ≈	1M3	499k	226k	93k1	14k	[Ω]

Trim down	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	[%]
$Vout_{set}$ =	108.9	107.8	106.7	105.6	104.5	103.4	102.3	101.2	100.1	99	[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	[%]
$Vout_{set}$ =	97.9	96.8	95.7	94.6	93.5	92.4	91.3	90.2	89.1	88	[V_{dc}]
R_{down} (E96) ≈	16k2	13k3	10k7	8k45	6k65	4k99	3k48	2k21	1k05	0	[Ω]

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

Parameter	Conditions	Value
Output Accuracy		±1.0% max.
Line Regulation	low line to high line, full load	0.1%
Load Regulation	10%-100% load	0.1% typ.
Transient Response	10-90% load, V_{in}= 16.8-137V_{dc}	0.5V_{dc}
	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			T30A, slow blow type
Short Circuit Protection (SCP)	constant current mode, auto recovery	CLS-300-6518	>110% of nom. output current
		CLS-300-6519	>110-125% of nom. output current
Short Circuit Input Current	V_{in}= 24V_{dc}		0.8A typ.
	V_{in}= 110V_{dc}		0.4A typ.
Input Reverse Polarity Protection	active protected		-137.5V_{dc}
Over Voltage Protection (OVP)	latch off	CLS-300-6518	28.8V_{dc} - 32.5V_{dc}
		CLS-300-6519	132V_{dc}-148.5V_{dc}
Over Voltage Category (OVC)	according to EN 50124-1:2018		OVC III

Parameter	Type			Value
Over Current Protection (OCP)	auto recovery		CLS-300-6518	>110%-125% of nom. output current
			CLS-300-6519	>110%-135% of nom. output current
Over Temperature Protection (OTP)	shut down, auto recovery			T_{amb}= >90°C
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		5kV_{dc} / 3.5kV_{ac}
		I/P to PE and O/P to PE		3kV_{dc} / 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_{ac}
			I/P to PE and O/P to PE	2.8kV_{dc}
Isolation Resistance				100MΩ min.
Isolation Capacitance				650pF max.
Leakage Current				10μA
Insulation Grade				reinforced
Internal Clearance	I/P to O/P			6mm
	I/P to PE			4mm
	O/P to PE			3mm

Note3: For repeat Hi-Pot testing, reduce the time and/or the test voltage

POWER GOOD

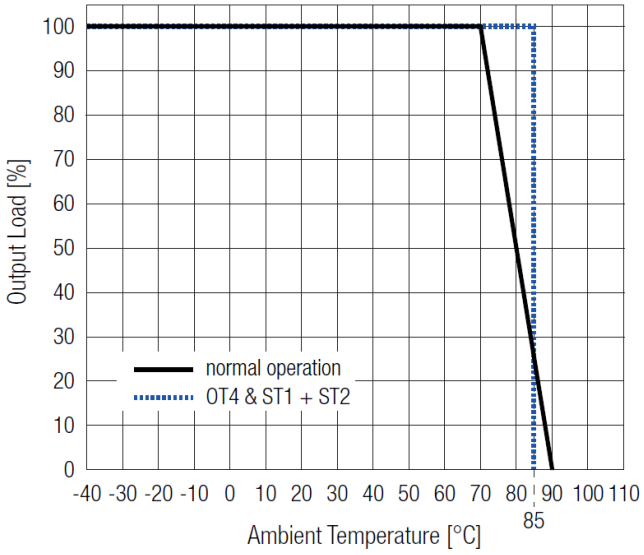
Parameter	Type		Value
Power OK LED	CLS-300-6518	V_{out}= >17V_{dc}	green
		V_{out}= <17V_{dc}	light off
	CLS-300-6519	V_{out}= >80V_{dc}	green
		V_{out}= <80V_{dc}	light off
Relay Status	CLS-300-6518	V_{out}= >17V_{dc}	OK: OK2 connected OK or OK1 not connected OK
		V_{out}= <17V_{dc}	NOK: OK1 connected to OK or OK2 not connected OK
	CLS-300-6519	V_{out}= >80V_{dc}	OK: OK2 connected OK or OK1 not connected OK
		V_{out}= <80V_{dc}	NOK: OK1 connected to OK or OK2 not connected OK
Relay Capability			0.5A/150V_{dc}

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	1360 x 10³ hours
		T_{amb}= +55°C	850 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

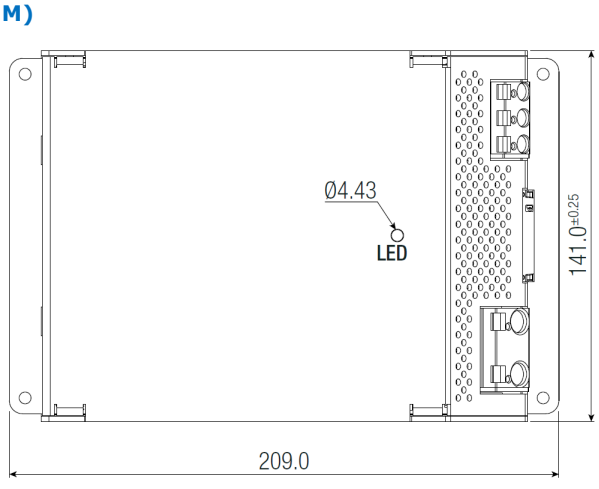
Certificate Type (Safety)	Standard
Audio/Video, information and communication technology equipment - Part1: Safety requirements 3rd Edition	IEC62368-1:2018 3rd Edition EN IEC 62368-1:2020+A11:2020
Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances 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	EN61000-6-4:2007+A1:2011
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8kV	IEC61000-4-2:2009, Criteria A EN61000-4-2:2008, Criteria A
Contact: ±2, 4, 6kV	IEC61000-4-2:2009, Criteria A EN61000-4-2:2008, Criteria A	IEC/EN61000-4-3:2006, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	20V/m (80-1000MHz)	IEC/EN61000-4-4:2012, Criteria A
10V/m (1000-2000MHz)	IEC/EN61000-4-3:2006, Criteria A	IEC/EN61000-4-5:2014, 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
Railway applications - Electromagnetic compatibility		EN50121-3-2:2016+A1:2019
Technical rules for electromagnetic compatibility: Verification of radio compatibility of rail vehicles with railway radio services		Regulation No. EMV 06:2019

DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	aluminum
Dimension (LxWxH)		209.0 x 141.0 x 48.0mm 8.23 x 5.55 x 1.89 inch
Weight		1100g typ. 2.43 lbs

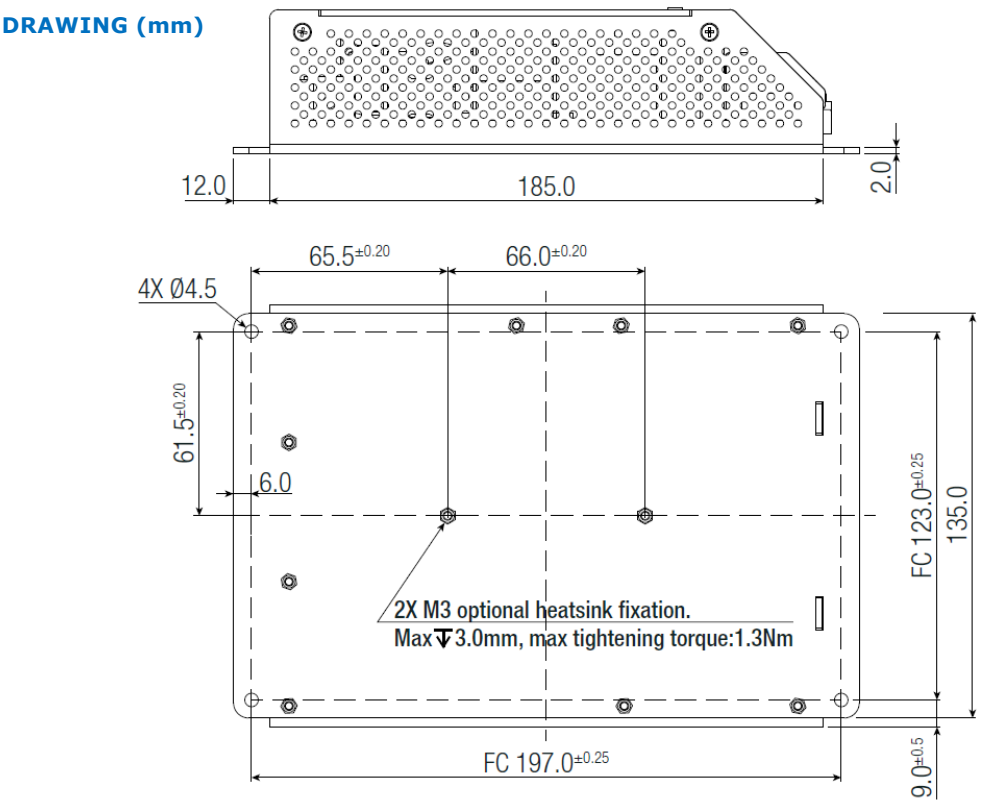
DIMENSION DRAWING (MM)

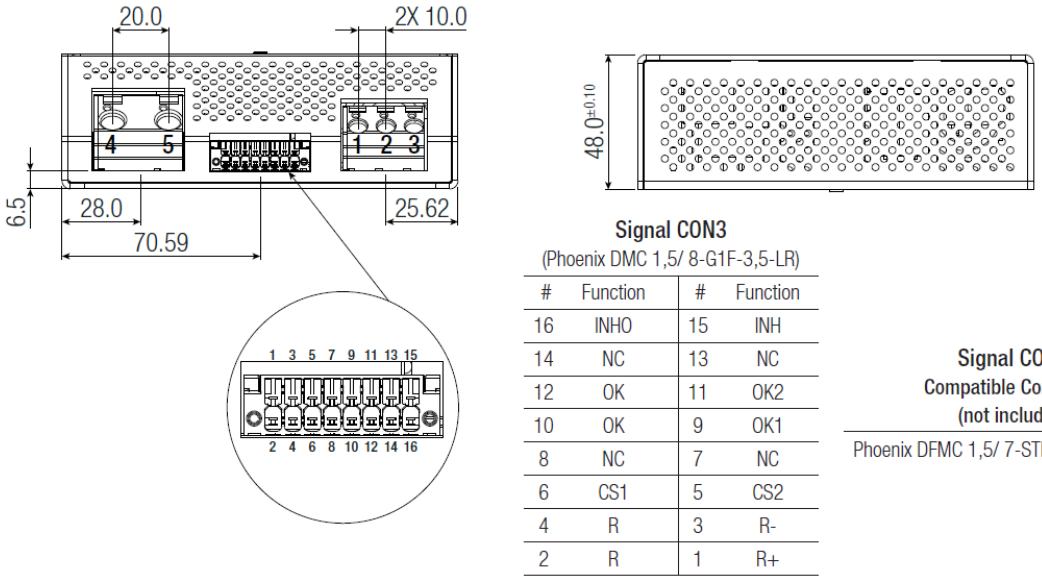


Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

FC = fixing centers

DIMENSION DRAWING (mm)





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

#	Function	#	Function
16	INHO	15	INH
14	NC	13	NC
12	OK	11	OK2
10	OK	9	OK1
8	NC	7	NC
6	CS1	5	CS2
4	R	3	R-
2	R	1	R+

Signal CON3
Compatible Connector (not included)

Phoenix DFMC 1,5/ 7-STF-3,5 – 1790357

Input connector CAGE CLAMP® CON1
(WAGO 745-353)

#	Function	AWG	Wire diameter
1	-Vin	24-10	0.25-4mm²
2	+Vin	24-10	0.25-4mm²
3	PE	24-10	0.25-4mm²

wire stripping length: 11-12mm
Conductor connection direction to PCB 45°

Output connector CAGE CLAMP® CON2
(WAGO 745-602/006-000)

#	Function	AWG	Wire diameter
4	+Vout	24-6	0.25-10mm²
5	-Vout	24-6	0.25-10mm²

wire stripping length: 12-13mm
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

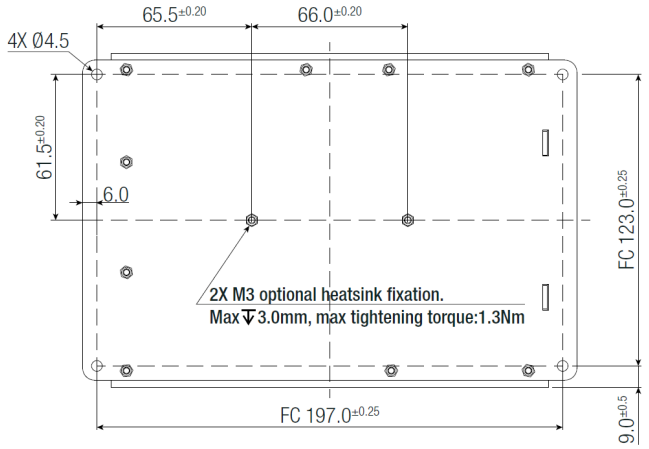
FC = fixing centers

ACCESORIES

Accesories	Notes	Order qty. / device	CODE
Signals mating connector	DEGSON 15EDGKNG-3.5-XXP-1Y-1000A(H)	1	2601-1120

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.

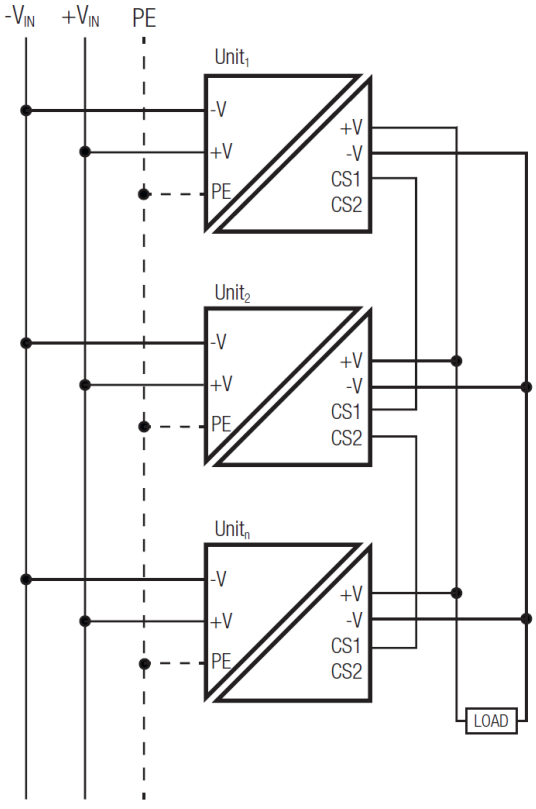
The RMD converter has to be installed with 4 x M4 screws and can be mounted in any mounting direction.

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.

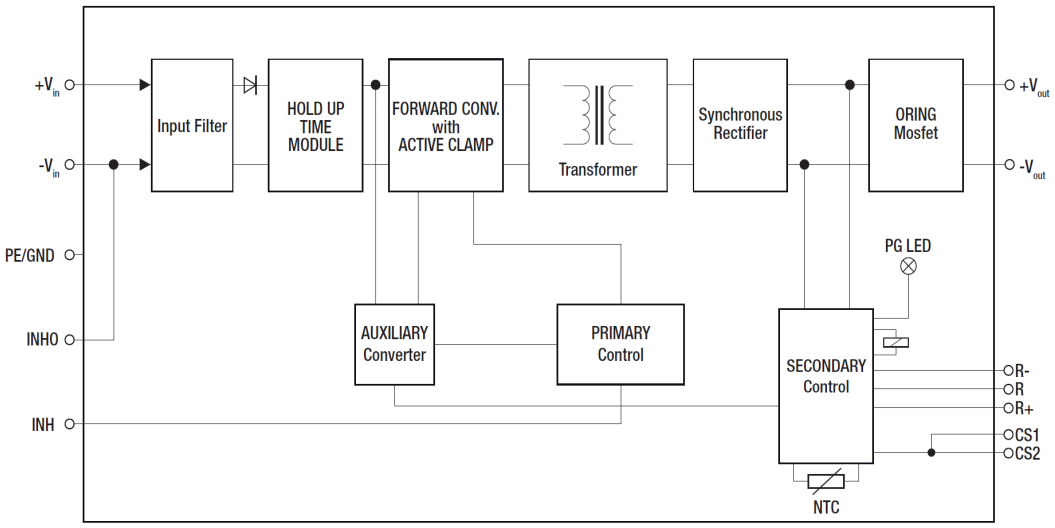
INSTALLATION & APPLICATION

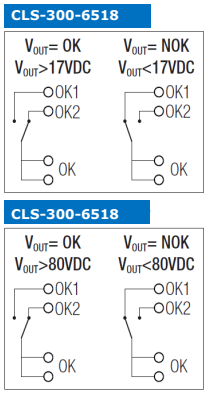
PARALLEL OPERATION

Here the example of three parallel connected units. CS1/CS2 is a double connection of the same pin to be able to connect more than two units.



BLOCK DIAGRAM





PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	cardboard box	145.0 x 53.0 x 218.0mm
Packaging Quantity		1pc
Storage Temperature Range		-40°C to +85°C