Premium
Powering Your Challenge

CLS-75

75W / ULTRA-WIDE INPUT 16.8V-137.5VDC

GENERAL FEATURES

- Fully EN50155 compliant, no external circuits
- Ultra-wide input range 11:1 reduces product variety
- Excellent efficiency, lowest power loss, full life-time
- Full power up to +85° without heat sink, no de-rating
- 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
- 20% Peak load capability to 90W for 10s
- Remote (on/off) and DC OK with open collector
- 2 years warranty

Dimensions (LxWxH): 110.0 x 73.0 x 40.0mm (4.33 x 2.78 x 1.57 inch) 240g (0.53 lbs)

SAFETY & EMC

CE UKCA ROHS REACH

APPLICATIONS

DESCRIPTION

The chassis mountable CLS-75 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 92% 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-75-24	16.8-137.5	24	3.75	92.5	90

Note1: Refer to "Peak load Capability"

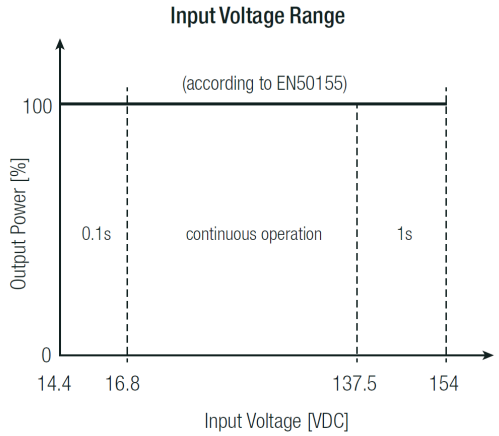
MODEL NUMBERING

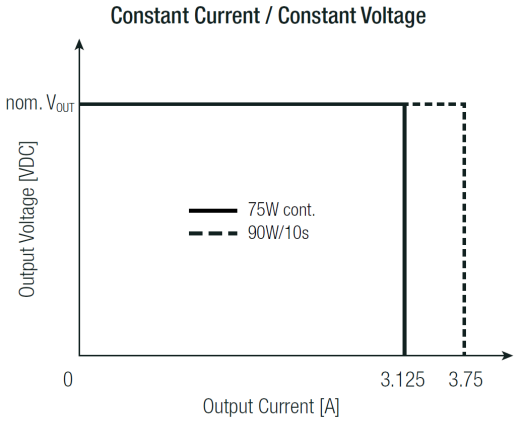
CLS-75-24

Nominal Power — nom. Output Voltage

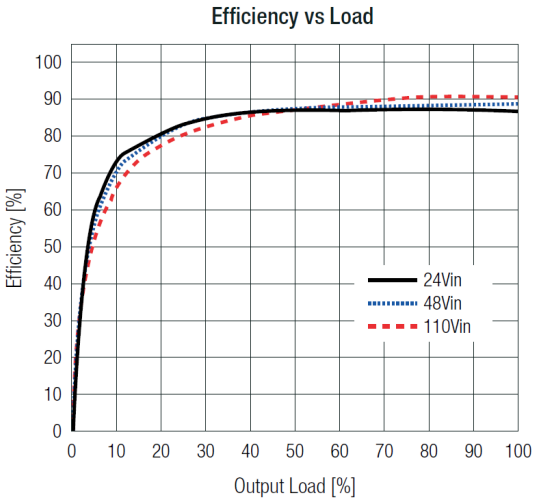
BASIC CHARACTERISTICS (Measured at Tamb = 25°C, nominal Vin, full load, and after warm-up, unless otherwise stated.)

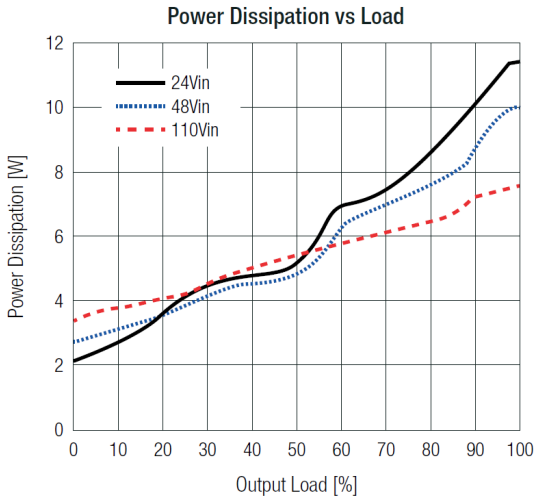
Parameter	Conditions			Min.	Typ.	Max.
Input Voltage Range	refer to "Input Voltage Range"	nom. V_{IN}= 24, 36, 48, 72, 110VDC		16.8VDC		137.5VDC
		according to EN 50155	100ms max	14.4VDC		16.8VDC
			1s max.	137.5VDC		154VDC
Input Capacitance	internal				4µF	
Under Voltage Lockout	rising edge			15VDC	16VDC	
	falling edge					14.4VDC
	hysteresis				1VDC	
Input Current	V_{IN}=16.8VDC			5.1A	5.45A	6.1
	V_{IN}= 24VDC			3.5A		4.2A
	V_{IN}= 110VDC			0.75A		
	V_{IN}= 137.5VDC				0.6A	
Inrush Current	active inrush current limitation (<3.5 x Inom)					14A
No Load Power Consumption	V_{IN}= 16.8VDC				1.9W	
	V_{IN}= 110VDC				1.4W	
Standby Power (shutdown by remote)						0.5W
Output Current Range	continuous operation			0A		3.125A
	10s max., refer to "Peak load Capability"					3.75
Output Voltage					24VDC	
Output Voltage Trimming				21.6VDC		26.4VDC
Minimum Load				0%		
Start-up time	V_{IN}= 24VDC				0.5s	
	V_{IN}= 110VDC				0.2s	
	by using CTRL ON/OFF function					0.2s
Rise time	V_{IN}= 24VDC, 110VDC					100ms
Hold-up time	V_{IN}= 24VDC				25ms	
	V_{IN}= 48VDC				15ms	
	V_{IN}= 110VDC				10ms	
ON/OFF CTRL	DC-DC ON			open or connected to $+V_{IN}$		
	DC-DC OFF			connected to $-V_{IN}$		
Input Current of CTRL pin	DC-DC ON					10mA
Internal Operating Frequency					88kHz	
Output Ripple and Noise	10µF electrolytic capacitor in parallel across the output (low ESR)	ripple			1% of V_{OUT}	
		noise			2% of V_{OUT}	
Maximum Capacitive Load					4000µF	





BASIC CHARACTERISTICS (Measured at Tamb = 25 °C, nominal Vin, full load, and after warm-up unless otherwise stated.)





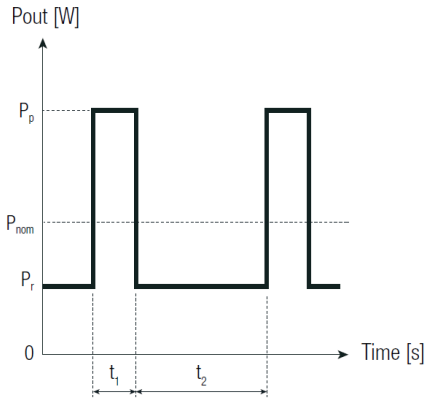
PEAK LOAD CAPABILITY

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 (90W max)	[W]
P_r	= recovery power	[W]
t_1	= peak time (10s max)	[s]
t_2	= recovery time (calculated)	[s]

Calculation:

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



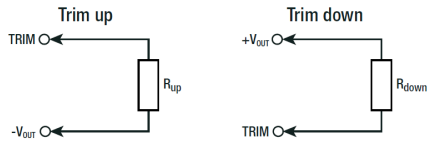
Practical Example:

P_{nom} = 75W
P_p = 90W
P_r = 60W
t_1 = 10s

$$t_2 = \frac{(75W - 90W) \times 10s}{60W - 75W} = \underline{10s}$$

OUTPUT VOLTAGE TRIMMING

The output voltage of the CLS-75 can be trimmed between ±10% 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:



R_1 [Ω]	R_2 [Ω]	R_3 [Ω]	V_{ref} [VDC]
35k3	4k1	6k	2.5

$Vout_{nom}$ = nominal output voltage [VDC]
$Vout_{set}$ = trimmed output voltage [VDC]
V_{ref} = reference voltage [VDC]
R_{up} = trim up resistor [Ω]
R_{down} = trim down resistor [Ω]
k_u = trim up factor [ ]
k_d = trim down factor [ ]

Calculations:

$$k_u \cong \frac{V_{REF} \times R_1}{V_{OUTset} - V_{REF}} \qquad R_{up} \cong \frac{k_u \times R_2}{R_2 - k_u} - R_3$$

$$k_d \cong \frac{(V_{OUTset} - V_{REF}) \times R_2}{V_{REF}} \qquad R_{down} \cong \frac{k_d \times R_1}{R_1 - k_d} - R_3$$

Practical Example trim up +10% for CLS-75-24

$Vout_{set}$ = 26.4VDC; $Vout_{nom}$ = 24VDC

$$k_u = \left[\frac{2.5V \times 35k3}{26.4V - 2.5V}\right] = 3692.47$$

$$R_{up} = \left[\frac{3692.47 \times 4k1\Omega}{4k1\Omega - 3692.47}\right] - 6k\Omega = 31148\Omega$$

R_{up} according to E96 ≈ 30k9Ω

Practical Example trim down -10% for CLS-75-24

$Vout_{set}$ = 21.6VDC; $Vout_{nom}$ = 24VDC

$$k_d = \left[\frac{(21.6V - 2.5V) \times 4k1\Omega}{2.5V}\right] = 31324$$

$$R_{down} = \left[\frac{31324 \times 35k3\Omega}{35k3\Omega - 31324}\right] - 6k\Omega = 272103\Omega$$

R_{down} according to E96 ≈ 274kΩ

Trim up	1	2	3	4	5	6	7	8	9	10	[%]
$Vout_{set}$ =	24.2	24.5	24.7	25.0	25.2	25.4	25.7	25.9	26.2	26.4	[VDC]
R_{up} (E96) ≈	499k	178k	124k	84k5	69k8	59k	46k4	41k2	34k8	30k9	[Ω]

Trim down	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	[%]
$Vout_{set}$ =	23.8	23.5	23.3	23.0	22.8	22.6	22.3	22.1	21.8	21.6	[VDC]
R_{down} (E96) ≈	3M32	1M4	1M	402k	576k	487k	402k	357k	301k	274k	[Ω]

REGULATIONS (Measured at Tamb = 25 °C, nominal Vin, full load, and after warm-up, unless otherwise stated.)

Parameter	Conditions	Value
Output Accuracy		±3.0% max.
Line Regulation	low line to high line, full load	±0.5% max.
Load Regulation	0%-100% load	2.0% max.
Transient Response	10-90% load, VIN= 16.8-137VDC	1.2VDC
	recovery time	40ms typ.

PROTECTIONS (Measured at Tamb = 25 °C, nominal Vin, full load, and after warm-up, unless otherwise stated.)

Parameter	Type	Value
Internal Input Fuse		T20A, slow blow type
Short Circuit Protection (SCP)	constant current mode, auto recovery	>110%-135 of nom. output current
Short Circuit Input Current	V_{IN}= 24VDC	0.6A
	V_{IN}= 110VDC	0.2A
Input Reverse Polarity Protection	active protected	-137.5VDC
Over Voltage Protection (OVP)	latch off	120-150% of nom. V_{OUT}
Over Voltage Category (OVC)	short term and continuous	OVC II
Over Current Protection (OCP)	auto recovery	120%-130%
Over Temperature Protection (OTP)	auto recovery	105°C internal
Class of Equipment		Class I
Isolation Coordination	according to EN 50124-1:2018	V_{NOM}= 250VDC
Isolation Voltage (2)	I/P to O/P	4.2kVDC
	I/P to case, OK contact to I/P, O/P and case	2.2kVDC
	O/P to case	1.5kVAC
Isolation Resistance		300MΩ min.
Isolation Capacitance		1200pF typ.
Insulation Grade		reinforced
Internal Clearance	I/P to O/P	5mm
	I/P to PE, O/P to PE	2.5mm

POWER GOOD

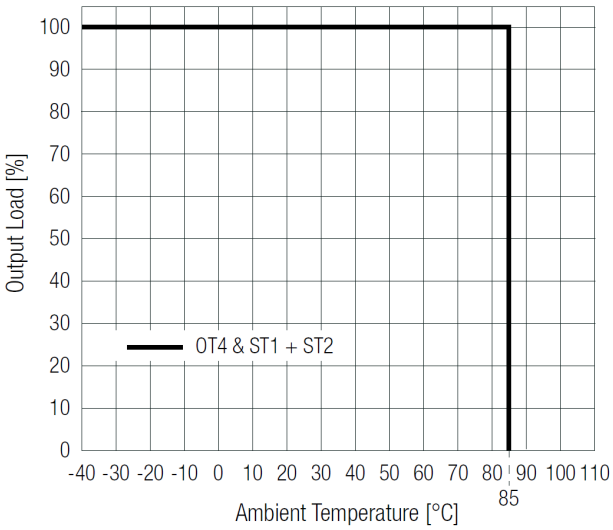
Parameter	Type	Value
Power OK LED	V_{OUT}= >21.6VDC	green
	V_{OUT}= <21.6VDC	light off
Open Collector	V_{OUT}= >21.6VDC	OK= 5V/1mA
	V_{OUT}= <21.6VDC	NOK= 0V

ENVIRONMENTAL (Measured at Tamb = 25 °C, nominal Vin, full load, and after warm-up, unless otherwise stated.)

Parameter	Conditions		Value
Operating Ambient Temperature Range	according to EN 50155 operating temperature class OT4 and extended operating temperature class ST1 & ST2	without derating	-40°C to +70°C
		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		5000m
Operating Humidity	non-condensing		95% RH max.
Conformal Coating (3)	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

Note3: 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	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	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	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. Safety requirements	IEC/EN62368-1:2020+A11:2020
Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment	EN50124-1
Railway Applications - Electrical Equipment used on rolling stock	EN50155
RoHS2	RoHS 2011/65/EU + AM2015/863

EMC Compliance	Conditions	Standard / Criterion
Railway applications - Electromagnetic compatibility		EN50121-3-2:2016
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, 8kV	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) 5V/m (2000-4000MHz) 3V/m (4000-6000MHz)	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)	IEC61000-4-6: 2016, Criteria A EN61000-4-6:2016, Criteria A
Technical rules for electromagnetic compatibility: Verification 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)		110.0 x 73.0 x 40.0mm 4.33 x 2.87 x 1.57 inch
Weight		240g typ. 0.53 lbs

DIMENSION DRAWING (MM)

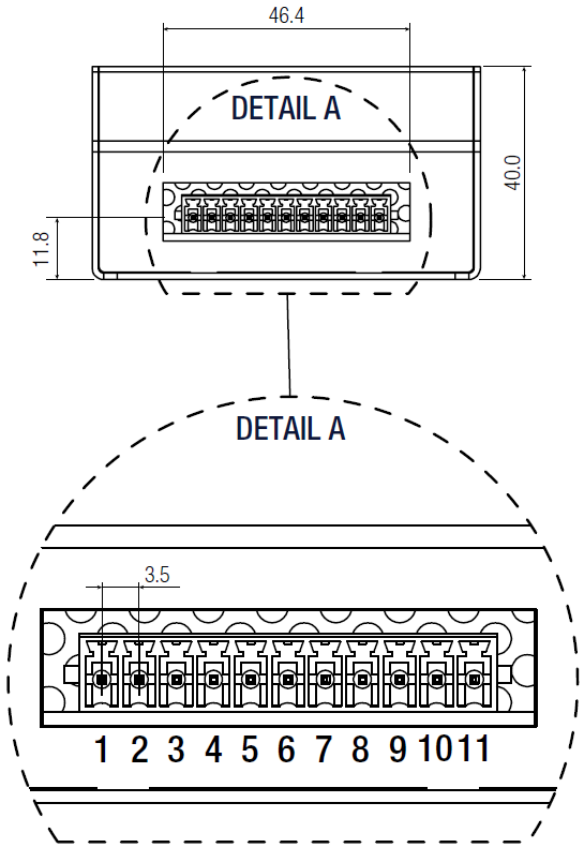
Connector Information

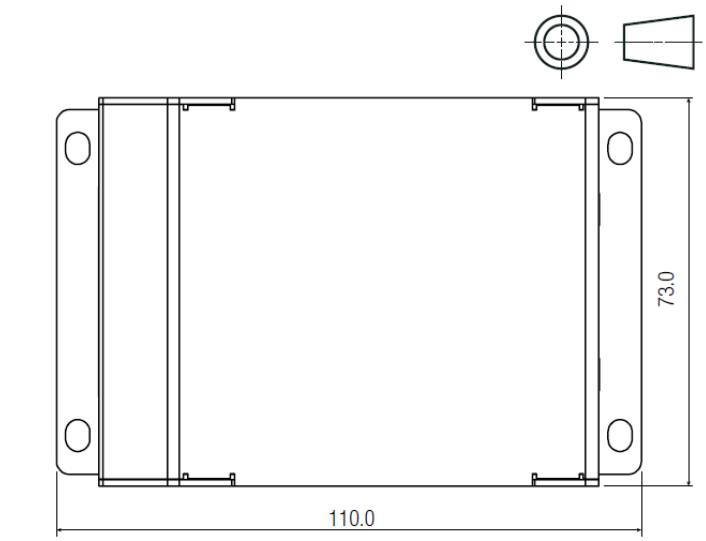
DEGSON 15EDGRN-3.5-11P-1Y-00Z(H)

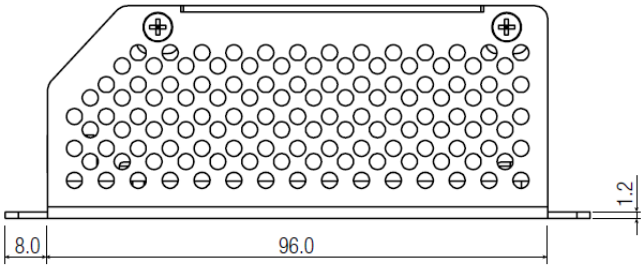
#	Function	#	Function
1	$+V_{OUT}$	7	PE
2	$-V_{OUT}$	8	NC
3	PG	9	$+V_{IN}$
4	PG	10	$-V_{IN}$
5	TRIM	11	RC
6	NC		

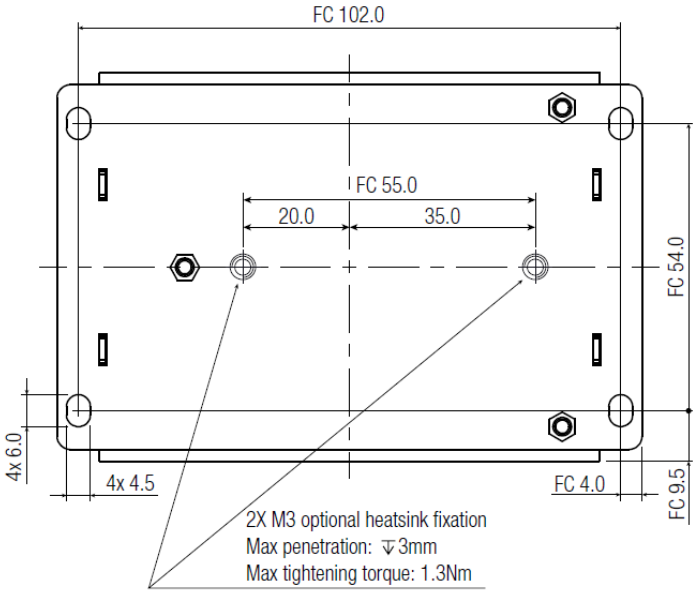
Compatible Connector

DEGSON 15EDGKNG-3.5-XXP-1Y-1000A(H)







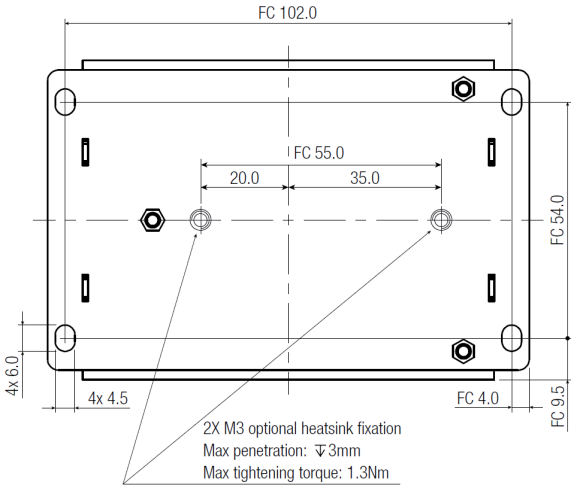


Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

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.

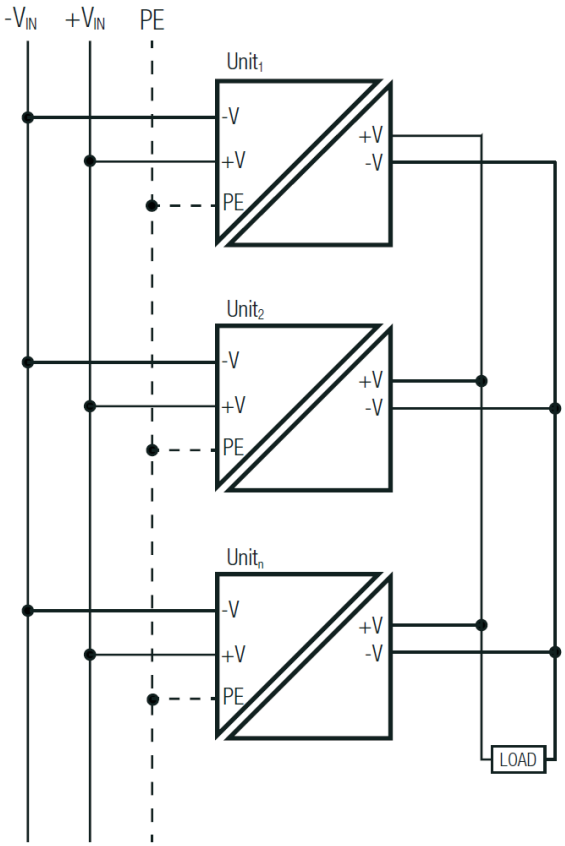
The converter has to be installed with 4 x M4 screws and can be mounted in any mounting direction.

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.

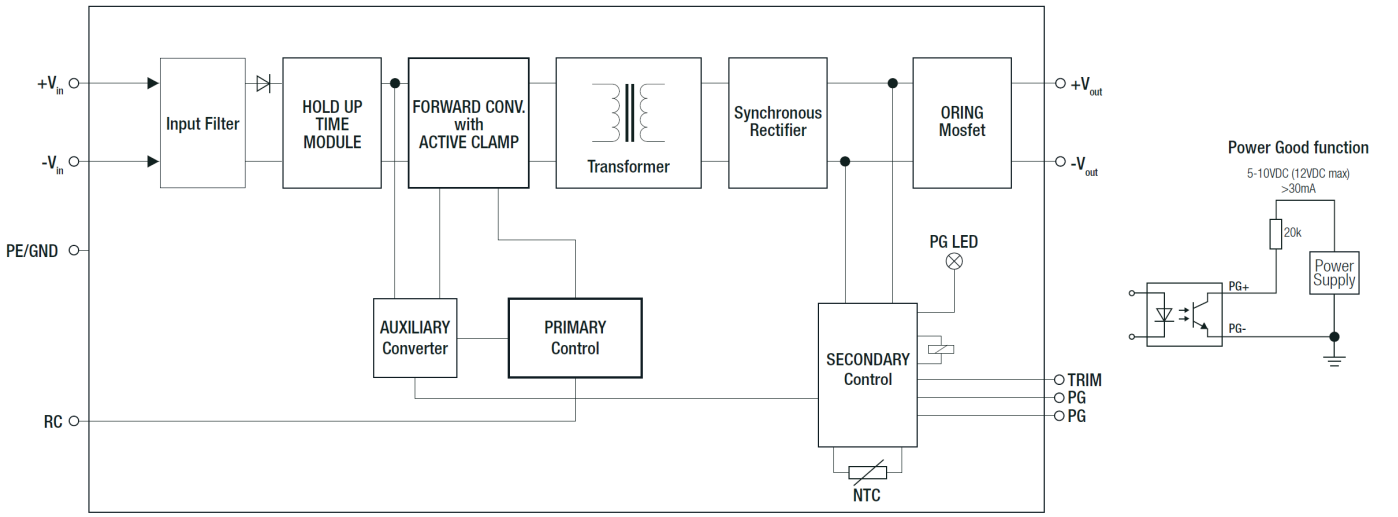
INSTALLATION & APPLICATION

PARALLEL OPERATION

Here the example of three parallel connected units.



BLOCK DIAGRAM



PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	cardboard box	130.0 x 48.0 x 100.0mm
Packaging Quantity		1pc
Storage Temperature Range		-55°C to +85°C