

P R B X

POWERBOX Defense Line
DAA/DAB/DAC Series
150W to several kW
DC/DC Conduction Cooled
Manual

Features

12, 24, 48, 72, 110VDC in

3 packages 150, 300W, 500W

Output from 3V3 to 48VDC

Input filtering EN55022 & transient protection

Reverse polarity protection

Several outputs, parallel or series operations up to several kW

MILSTD1275, 461, 810, 704 options

Safety IEC/EN60950-1, ROHS lead-free-solder compliant

Description

The DAA/DAB/DAC, very compact DC/DC converter in chassis mount format, incorporates input filtering, input and output protections, very robust mechanical mounting and connection, optional conformal coating, required in most of the severe environment for industrial, railways, defense type of applications. The converter provides high reliability, high efficiency, input-to-output isolation, soft start, overtemperature protection, input over/undervoltage lockout. The converters wide range of inputs are protected against surges and transients and EMI filtered. The outputs are continuously short-circuit proof. The 100°C baseplate operation allows operation in high temperature environment. The output can be configured in many different output voltages from 3V3 to 48VDC, can be put in series and parallel, others possibilities are even possible as semi-standard versions. Wide range of accessories like input & output Bus bars, N+1 oring diodes, parallel cables are available to simplify multi units assemblies. Military options (M) make it suitable for MIL STD compliance.

Options

Heatsink (H)	The unit is built as standard with a aluminum baseplate as described in the mechanical data. The converter can be delivered with a 15mm heatsink.
Ruggedized (M)	The unit can be ruggedized to meet MIL-STD810E, MIL-STD461E CE102. M option with 12 and 24Vin will comply with MIL STD 1275A on DAA and DAB only.
-40°C operation (T)	The thermal grade of the components are comply with low ambient temperature.
Conformal coating (V)	During manufacturing process components and pcb are covered with an acrylic coating to address high level of ambient humidity application.



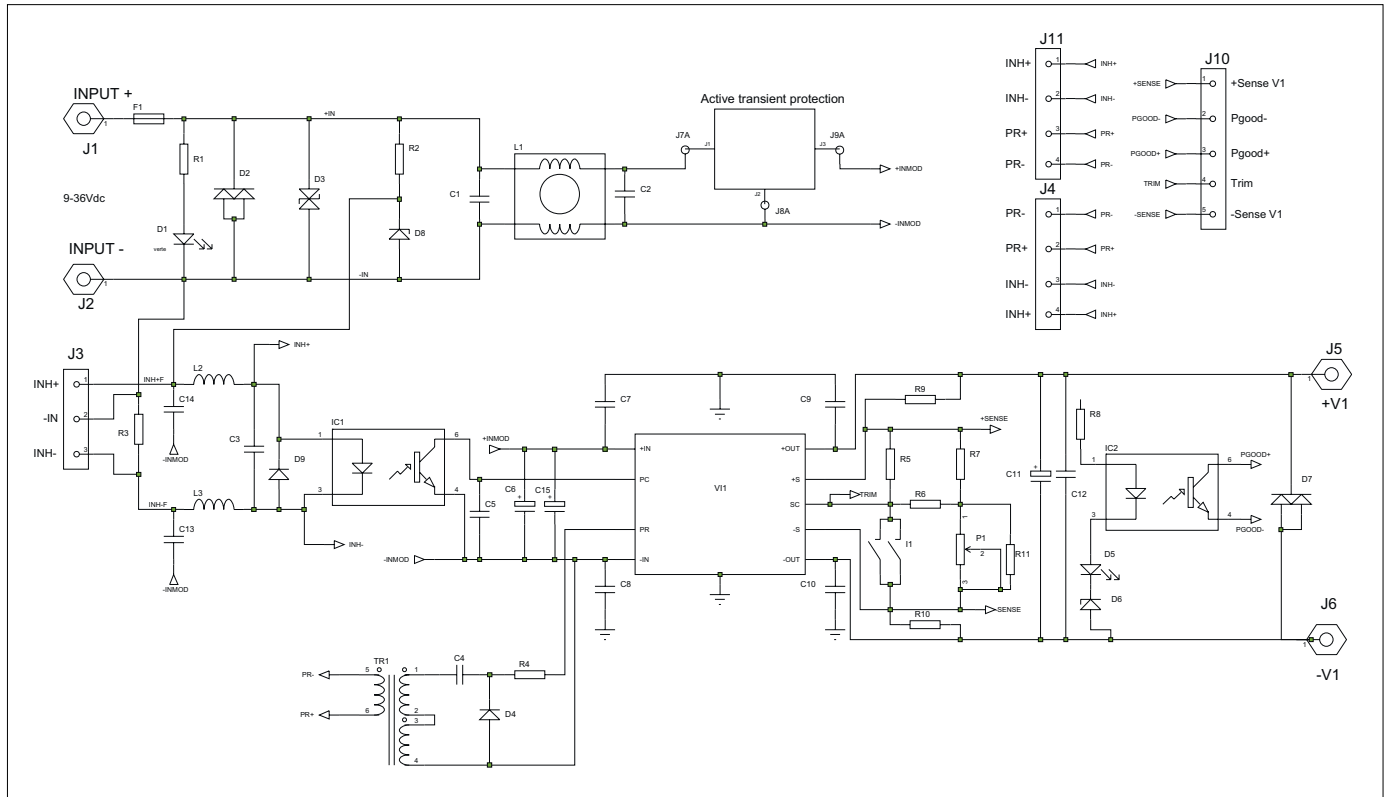
Input

Electrical input data	See table, page 2.
Input fuse	A fuse mounted inside the converter protects against damages in case of a failure. The fuse is not user-accessible.
Input transient protection	A VDR (Voltage Dependent Resistor) and a common mode input filter form an effective protection against input transients in severe environments like railways. When M option is defined for DAA500 and DAB300 Series, the unit is incorporating an active protection against high energy transient MIL STD 1275, DO160.
Input reverse polarity	A diode placed internally across the input will cause the fuse to blow in case of a reverse polarity of input voltage.

Accessories

Input parallel bus bar with capacitor footprints	The input bus bar simplifies the assembly of 2 or 3 units. It includes input extra capacitor footprints for application with long length from the source to the converter.
Output parallel bus bar	Available for 2up & 3up versions, it connects together the different positive outputs as well as negative output.
Output serial bus bar	It connects the negative of the first unit with the positive of the second to create high voltage configuration.
Output N+1 bus bar including diode	From 1up to 4up, this accessory puts in parallel the outputs with the addition of an oring diode mounted on an aluminium bar.
Inhibition and parallel cable	These 50mm cables allow unit to current share in parallel and allow the user to inhibit all units at the same time.

POWERBOX Defense Line
DAA/DAB/DAC Series
150W to several kWs
DC/DC Conduction Cooled
Manual



Input Characteristics	Conditions	Model Number	24V			48V			72V			110V			Units		
			min	typ	max	min	typ	max	min	typ	max	min	typ	max			
Operating input voltage			9	36	18	36	36	75	43	110	66	143	V				
Input surge	<100ms				50		50		100		150		230	V			
Undervoltage turn-on					8.9		17.5	17.9		35		42		64	V		
Undervoltage turn-off					8.5		14.8	15.3		30		36.5		56	V		
Overvoltage turn-off					36.2		40	36.3	39.7	75.7		82.5	111	121	155	170	V
Input current	Vin min	DAA			30			33		16.2		11			7.2	A	
		DAB			21			16.5		8.2		7			3.6	A	
		DAC			15			10		3.7		4.2			1.8	A	
No load input power		DAA	8	17	8	14	8	16	11	17	11	15	11	15	W		
		DAB	6	11	6	7.8	6	11	8	11	7	9	7	9	W		
		DAC	3	10	3	7	3	5	5	7	3	5	3	5	W		
Input capacitance	No inrush limiting circuit	DAA	440		440			44		20		20			uF		
		DAB	270		270			44		10		10			uF		
		DAC	220		220			44		10		10			uF		
Start-up time		DAA	50		50			50		50		50			ms		
		DAB	50		50			50		50		50			ms		
		DAC	50		50			50		50		50			ms		

Parallel and Series Connection

A converter output can be connected in series with an output from a separate converter, an internal diode across each output is implemented internally. The maximum output current of a serial-connected outputs is limited by the output with the lowest current limit. Output voltages above 48V (SELV - Safety Extra Low Voltage) require additional safety measures in order to comply with international safety requirements. Parallel operation is possible with m-module & M-modules to increase output power (see below paralleling signal).

Redundant Systems Operation

When systems require a very high level of reliability and should work normally in the event of a failure, N+1 redundancy is implemented where N is the number of converter to support power requirement. If one converter fail, the remaining ones still delivers the power to the loads. Oring diodes are required to ensure proper N+1 operation (included with optional N+1 bus bar).

Hold-up time

The converter provides limited hold-up time. If a hold-up time is required (some railways applications for example), use external input capacitors of adequate size. Formula for additional external input capacitor:

$$C = 2 * P_{out} * t_h * 100 / (V^2 - V_i^2) / \eta$$

whereas :

C	= external input capacitance [mF]
P _{out}	= output power [W]
η	= efficiency [%]
t _h	= hold-up time [ms]
V _i	= minimum input voltage
V	= Input voltage level before interruption

Output Current Limitation

The converter output is continuously protected against short-circuit by a constant current limitation. The short circuit protection is unlimited, the operating area between nominal power and active protection area working in a constant current mode may lead to power above nominal, then over stress of the internal components.

Thermal Considerations

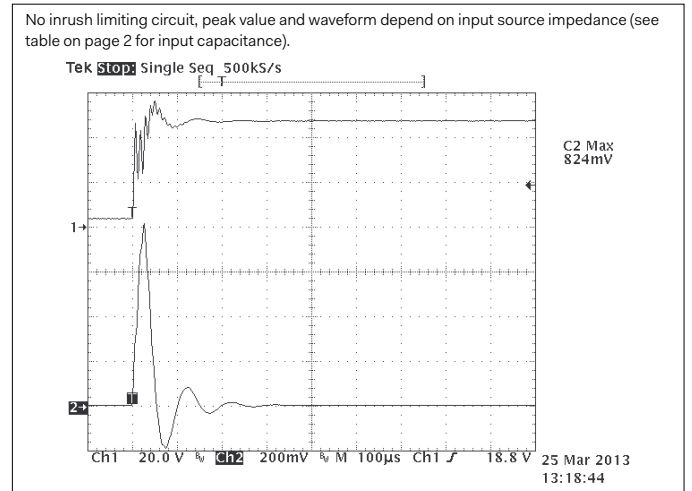
The converter is designed to be mounted on a dissipative area, in conduction cooling mode. The max. operating temperature is the temperature of the baseplate which should not exceed 100°C. Addition of grease or thermal pad between the converter baseplate and the chassis is mandatory .

Thermal Protection

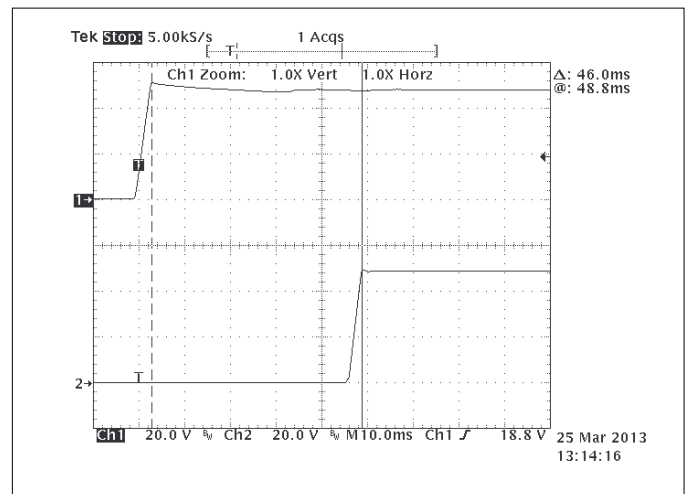
A temperature protection is integrated in each module, disabling output when heatsink temperature exceeds 105°C. The converter automatically restarts, when the temperature drops below this limit. Nevertheless, exceeding the max operating temperature may cause failures of the converter.

Waveforms

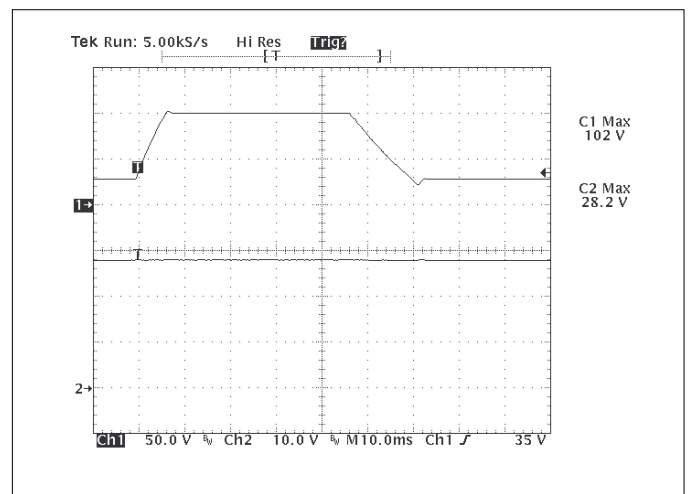
Inrush: DAB48-48250



Start-up time: DAB48-48250



100V 50ms Transient protection: DAA24-28400-M



Auxiliary Functions

Primary Inhibit (Remote On/Off)

The inhibit input disables (logic low, pull down or short circuit between INH- and -IN) or enables (logic high TTL, pull up or open-circuit) the converter. This signal is referenced to the input voltage and will disable/enable all outputs at the same time when inhibition & parallel cable is used. In systems consisting of several converters, this feature may be used to sequence the activation of the different converters if inhibition is used separately.

Output Voltage Adjustment

The converter outputs can be adjustable by potentiometer or an external voltage between trim and -sense (1,23V for nominal).

Sense Lines

This feature enable compensation of voltage drop across the connector contacts and the load lines. The voltage between any sense line and its respective power output pin (as measured on the connector) should not exceed the following values at nominal output voltage.

Output type	Total drop	Negative line drop
V1	<0.5V	<0.25V

Power Good

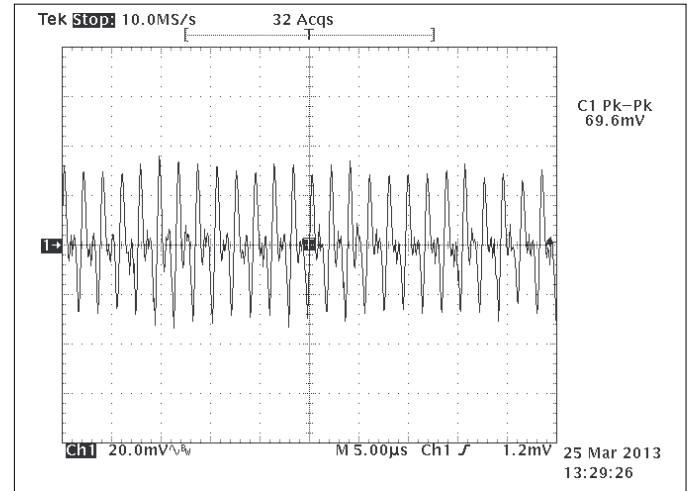
Two green leds at input & output indicate the presence of output voltages. An open collector PGood signal (J10) is open when output failed or closed when unit operates properly.

Paralleling Signal

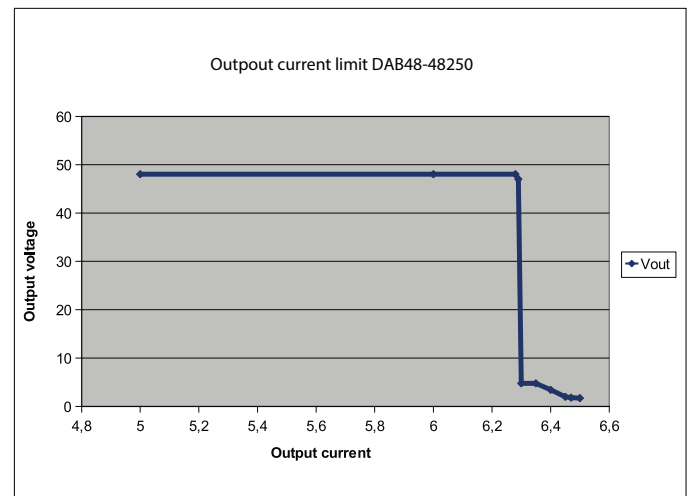
When several units of the same type are used in paralleled or in redundant system, the PR+ PR- of each unit need to be connected together through J4, J11 for accurate current sharing. Accessories cable can be used.

Waveforms

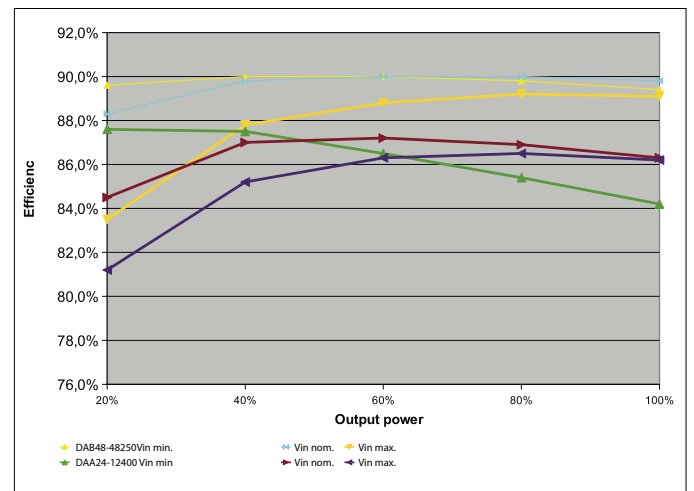
Output noise (DAB48-48250)



Current limitation (DAB48-48250)



Efficiency vs input & load DAB/DAB



POWERBOX Defense Line
DAA/DAB/DAC Series
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DC/DC Conduction Cooled
Manual

Environmental

Functionalities and Compliance Table

Functionalities	Conditions	Input 24V wide			Input 24V			Input 48V			Input 72V			Input 110V		
		DAA	DAB	DAC	DAA	DAB	DAC	DAA	DAB	DAC	DAA	DAB	DAC	DAA	DAB	DAC
Parallel operation	current share with PR connected	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓	
Redundant operation	R option or external diode	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓	
Series operation		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Remote senses		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
MIL COTS version	M option	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conformal coating	V option	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-40°C Operation	T option	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MIL-STD-704 A,C,D,E,F, 28V Steady State	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-704 A,C,D,E,F 28V Surges High Transients	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-704 A,C,D,E,F 28V Surges Low Transients	M option built to meet	✓	✓	✓												
MIL-STD-704 C,D,E,F 28V Surges Low Transients	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-704 A,C,D,E,F 28V Spikes	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-810E (Shocks/Vibrations/Accelerations/Humidity)	M, V option built to meet	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MIL-STD-461 Conducted Emission CE101, CE102	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-461 Conducted Susceptibility CS101, 114, 116	M option built to meet	✓	✓	✓	✓	✓	✓									
MIL-STD-1275 A,B,C,D Steady State, Surges and Spikes	100V/50ms, 250V/70uS M option	✓	✓		✓	✓										
RTCA-DO-160E sect.16 cat.Z, Surges	80V/100ms,48V/1s not meet M option	✓	✓	✓	✓	✓	✓									
DEF STAN 61-5, Part 6	28V 100V/50ms, M option	✓	✓	✓	✓	✓	✓									
ABD100.1.8 Surge and Normal Transients	M option	✓	✓	✓	✓	✓	✓									
EN50155 Environmental	V option	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EN50155, EN55022A, EN55011A, EN50121-3-2	Conduction Emission, built to meet	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EN 50155 Input Range and Transient	built to meet	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Electromagnetic Immunity

	Standard	Level	Value	Waveform	Source Impedance	Test Procedure	Mode
Supply surge	EN50155	B	1,4 * VIN	0,1 / 1 / 0,1 s	1 Ohm	1 positive surge	OP
Direct transients	EN50155	D	1800V	5 / 50 µs	5 Ohms	5 pos., 5 neg.	OP
Surges	EN 61000-4-5	3	2000V	1,2 / 50 µs	12 ohms		OP
Electrostatic discharge (to case)	EN 61000-4-2	4	8000V	1 / 50µs	330 Ohms	10 pos., 10neg.	OP
Electrical fast transients/burst	EN 61000-4-4	4	4000V	5 / 50µs	50 ohms		OP

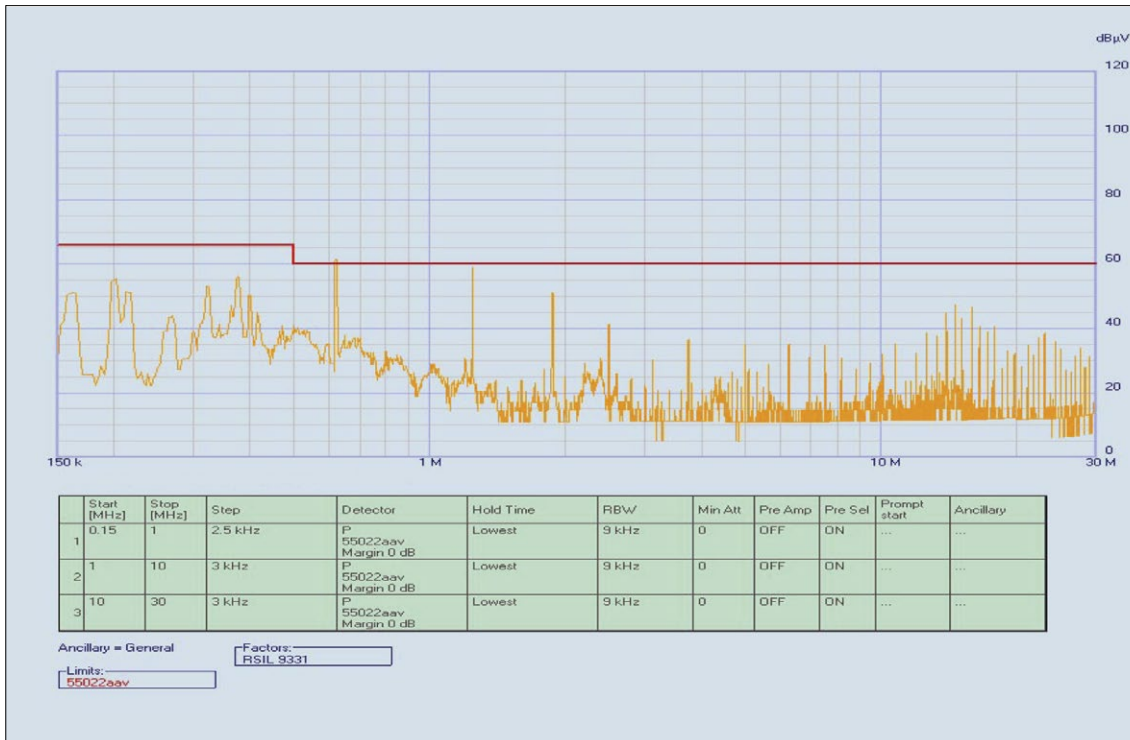
Immunity to Environmental Conditions

Test Method	Standard	Test Conditions	Status
Damp Heat	MIL STD 810E Proc. 507-2	Humidity 93 %, 40°C, 56 days	Conformal coating, built to meet
Shock	MIL STD 810E Proc.516.3	20g / 11ms	Built to meet
	EN 50155	5g / 30ms	
Vibrations	MIL STD 810E Proc. 514-3		Built to meet

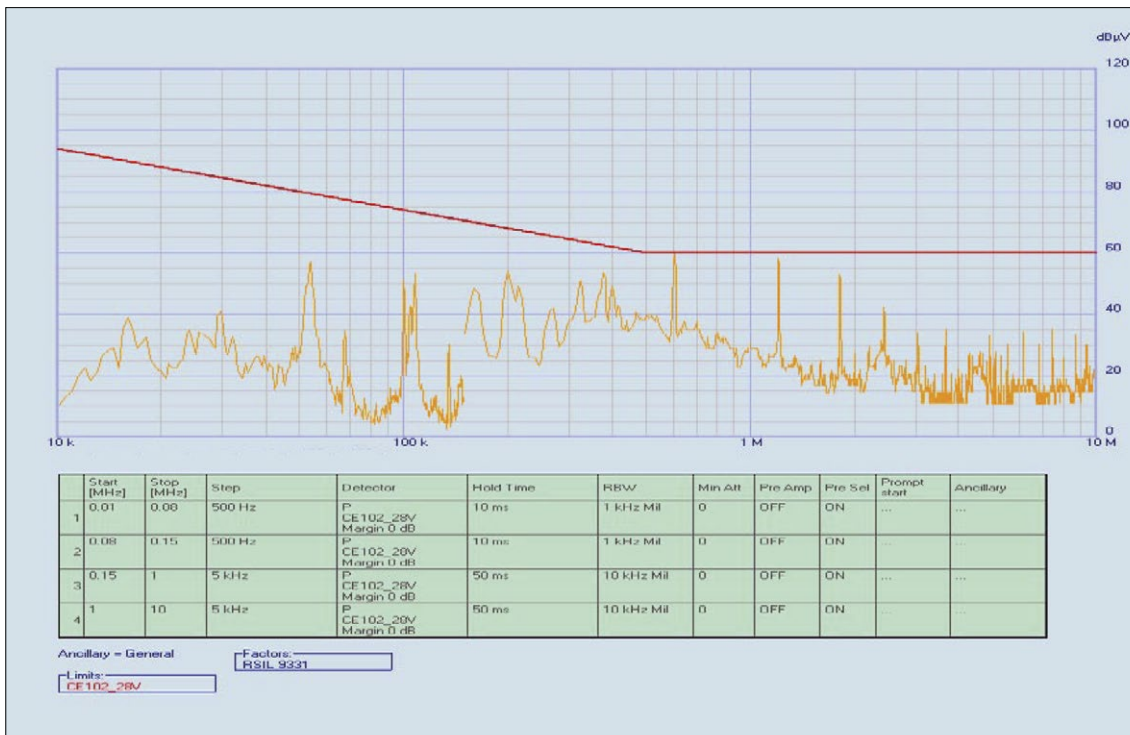
POWERBOX Defense Line
 DAA/DAB/DAC Series
 150W to several kW
 DC/DC Conduction Cooled
 Manual

Electromagnetic
 Electromagnetic Emissions DAA Series

Level according to EN55022A, peak detector, average limit, DAA24-24400, 400W



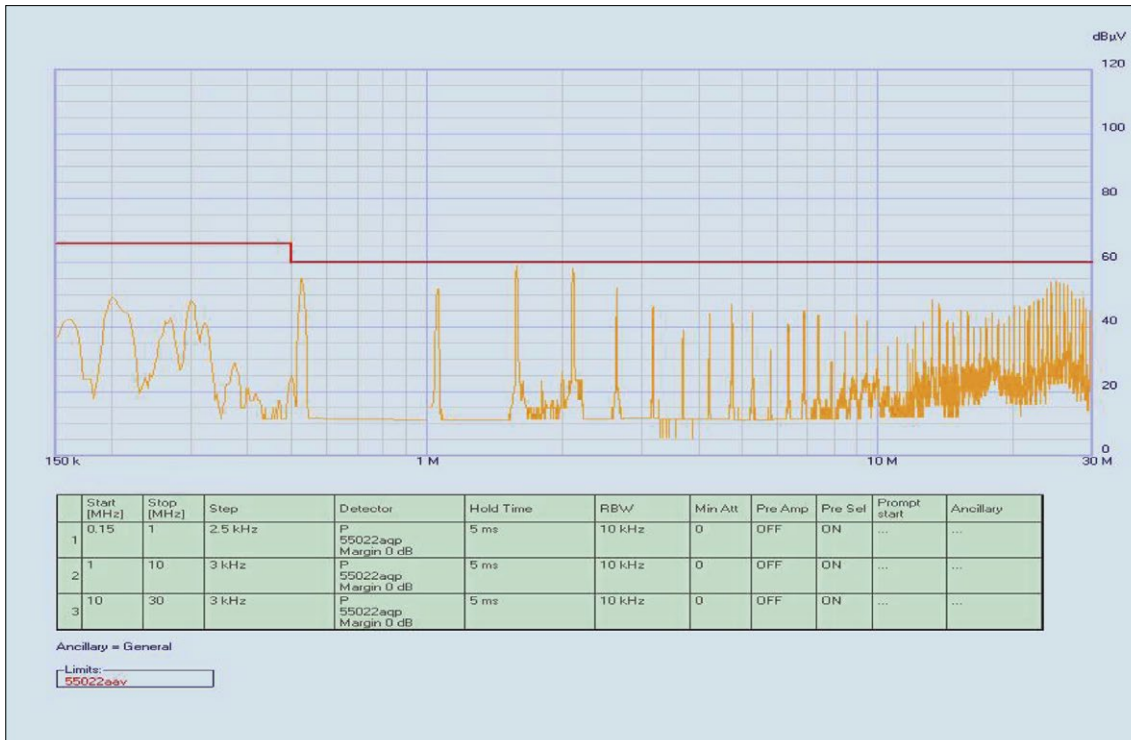
MIL-STD461 CE102, peak detector, 28V liit, DAA24-24400-M, 400W



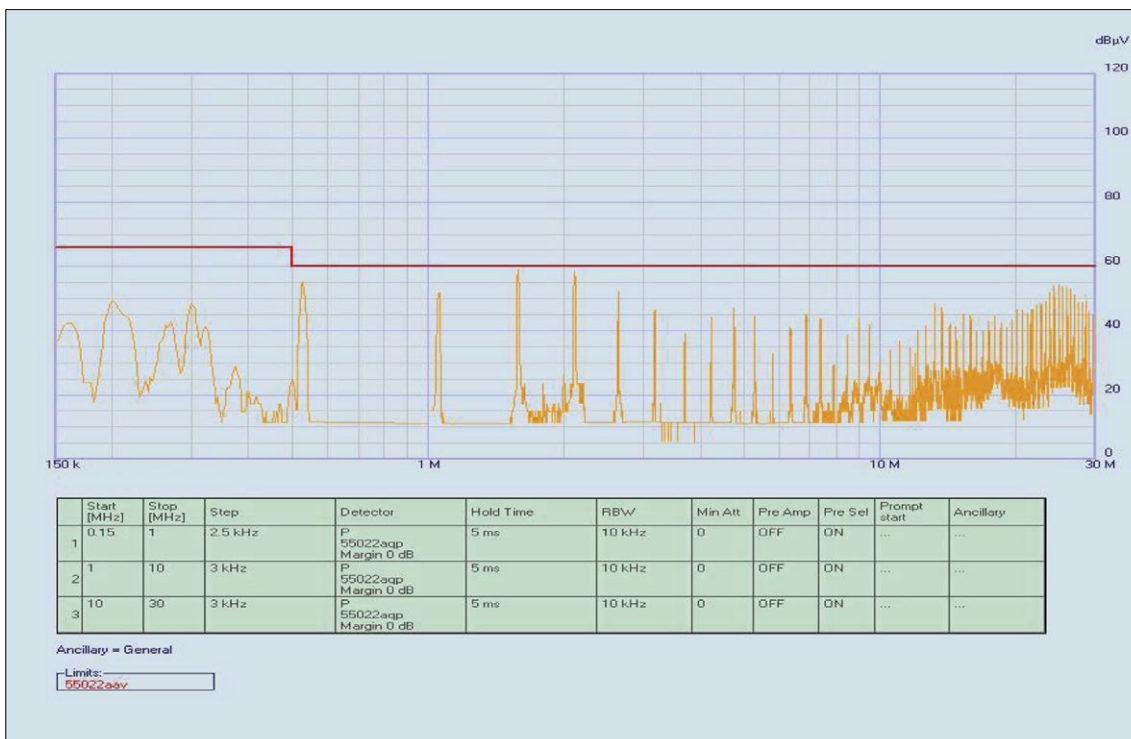
POWERBOX Defense Line
 DAA/DAB/DAC Series
 150W to several kW
 DC/DC Conduction Cooled
 Manual

Electromagnetic
 Electromagnetic Emissions DAB Series

Level according to EN55022A, peak detector, average limit, DAB28-12200, 200W



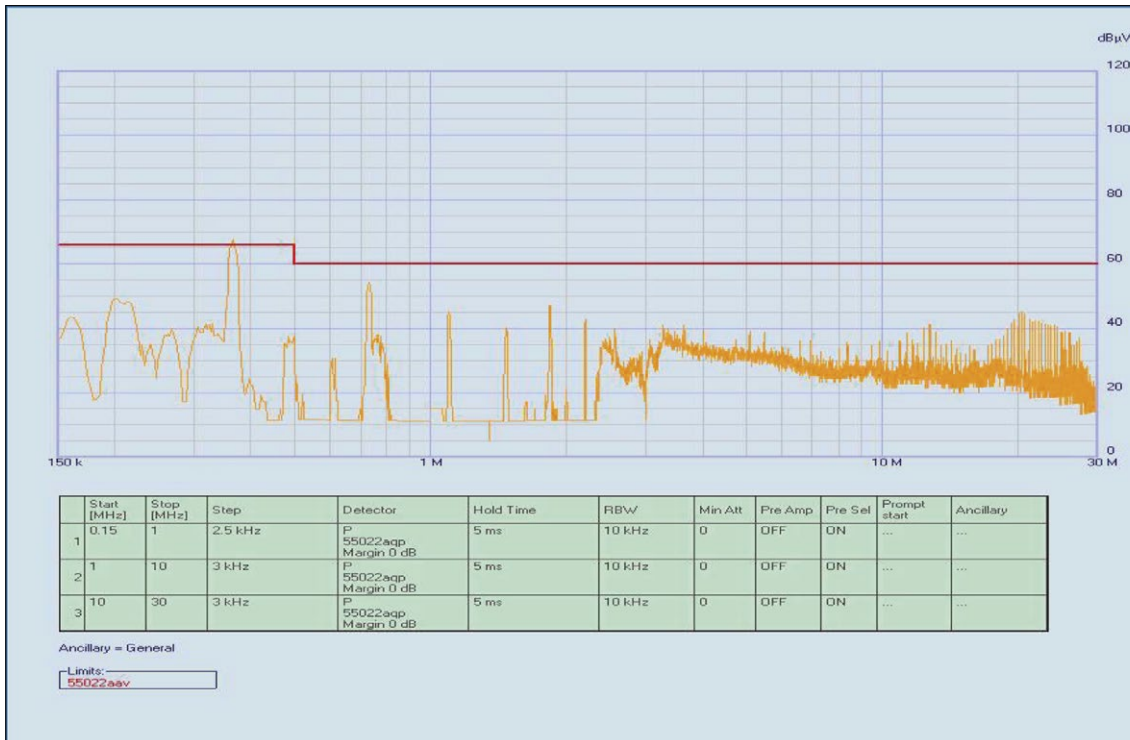
MIL-STD461 CE102, peak detector, 28V limit, DAB28-12200-M, 200W



POWERBOX Defense Line
 DAA/DAB/DAC Series
 150W to several kW
 DC/DC Conduction Cooled
 Manual

Electromagnetic
 Electromagnetic Emissions DAC Series

Level according to EN55022A, peak detector, average limit, DAC24-12100, 100W

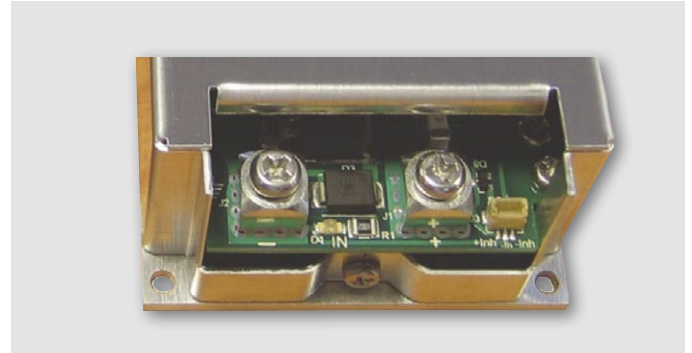


POWERBOX Defense Line
 DAA/DAB/DAC Series
 150W to several kW
 DC/DC Conduction Cooled
 Manual

Safety and Installation Instructions

Connector Pin Allocation

Pin	Description	
Press Fit M4: Würth ref. 7461095		
J1	INPUT +	
J2	INPUT -	
J5	+V1	Positive output voltage
J6	-V1	Negative output voltage
J3 : JST 3pts CMS ref. BM03B-SRSS-TB (LFSN)		
J3-1	INH +	See inhibition signal for description
J3-2	INPUT -	
J3-3	INH -	
J4 : JST 4pts CMS ref. BM04B-SRSS-TB (LFSN)		
J4-1	PR-	Parallel signal for multi unit connection
J4-2	PR+	Parallel signal for multi unit connection
J4-3	INH -	Inhibition signal for multi unit connection
J4-4	INH +	Inhibition signal for multi unit connection
J10 : JST 5pts CMS ref. BM05B-SRSS-TB (LFSN)		
J10-1	+ Sense V1 P	Positive remote sense
J10-2	Pgood -	Power Good emittor
J10-3	Pgood +	Power Good collector
J10-4	Trim	Voltage adjustment
J10-5 -	Sense V1	Negative remote sense
J11 : JST 4pts CMS ref. BM04B-SRSS-TB (LFSN)		
J11-1	INH +	Inhibition signal for multi unit connection
J11-2	INH -	Inhibition signal for multi unit connection
J11-3	PR+	Parallel signal for multi unit connection
J11-4	PR-	Parallel signal for multi unit connection



Installation Instructions

These converters are components, intended exclusively for integration into other equipment by an industrial assembly process or by a professionally competent person. Installation must strictly follow the safety regulations in respect of the enclosure, mounting, creepage and clearance distances, markings of the end-use application. Connection to the system shall be made via appropriate connection. The +Vin is internally fused. This fuse is designed to protect the converter against overcurrent caused by a failure, but may not be able to satisfy all requirements. External fuses in the wiring circuit to one or both input pins may be necessary to ensure compliance with local requirements. Do not open the converters, or the warranty will be invalidated. Make sure that there is sufficient heat dissipation available for conduction cooling. This should be verified by measuring the case of temperature at the specified measuring point, when the converter is operated in the end-use application.

Standards and Approvals

The converters are built to meet the safety standards IEC 60950-1, EN 60950-1. 'Built to meet' mentioned in the different paragraphs of the datasheet means that Powerbox has designed the product to meet the standard but not certified it in a laboratory.

Cleaning Agents and Process

The converters are not hermetically sealed. In order to avoid possible damage, any penetration of liquids shall be avoided.

Railway Application

The converters have been designed observing the railway standards EN 50155 and EN 50121. All boards can be protected by a conformal coating.

Isolation

The electric strength test is performed in the factory in accordance with IEC/EN 60950.

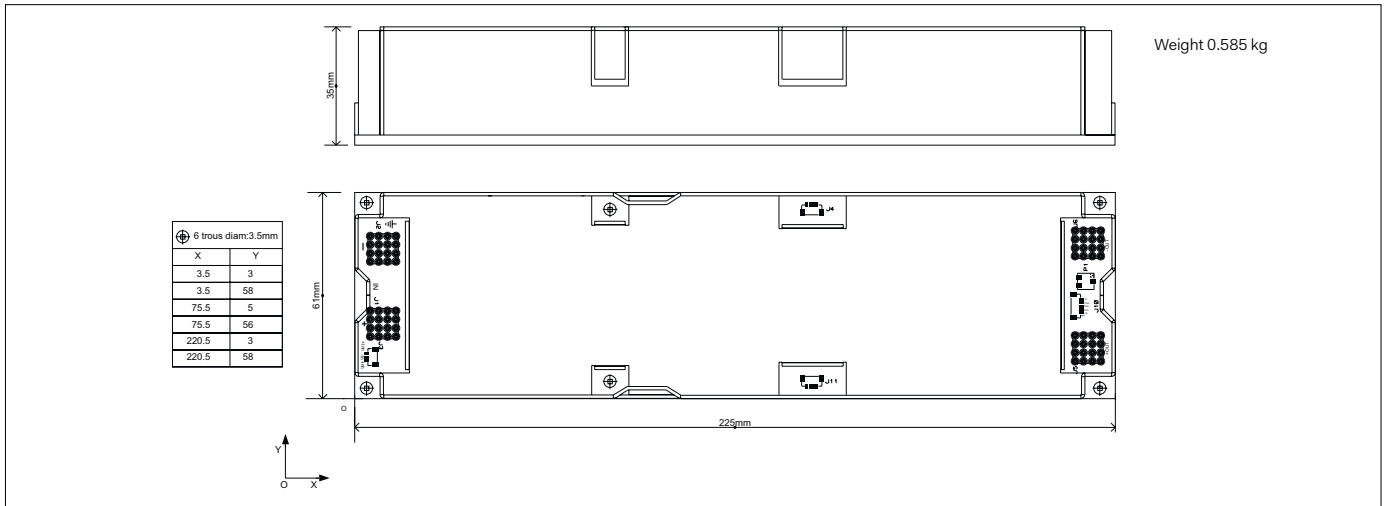
Electric Strength Characteristic		Input to Earth	Input to Output	Output to Earth	Output to Output	Unit
Electric strength	Design strength	1500	3000	500	Vrms	
	Factory test for production units (>10s)	2000	2000	500	Vdc	
Insulation resistance				> 100	>100	Mohms

Temperatures Conditions		Standard			T Option			Unit
		Min	Typ	Max	Min	Typ	Max	
Baseplate or heatsink	Operating	-20		+100	-40		+100	°C
Storage	Not operating	-40		+125	-40		+100	°C

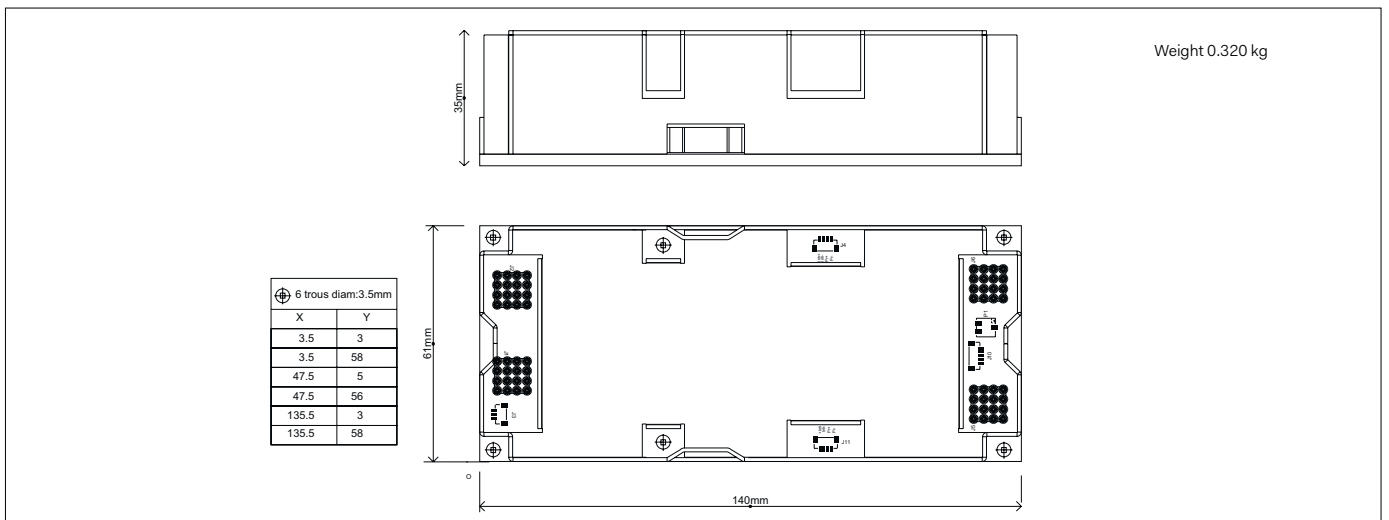
Reliability MIL-HDBK-217F, notice 2		Model	Heatsink		
			Temp	GB	GF
MTBF (hours)		DAA24-24400	40°C	1554000	777000
			70°C	914800	457400
			100°C	574810	287400

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 DC/DC Conduction Cooled
 Manual

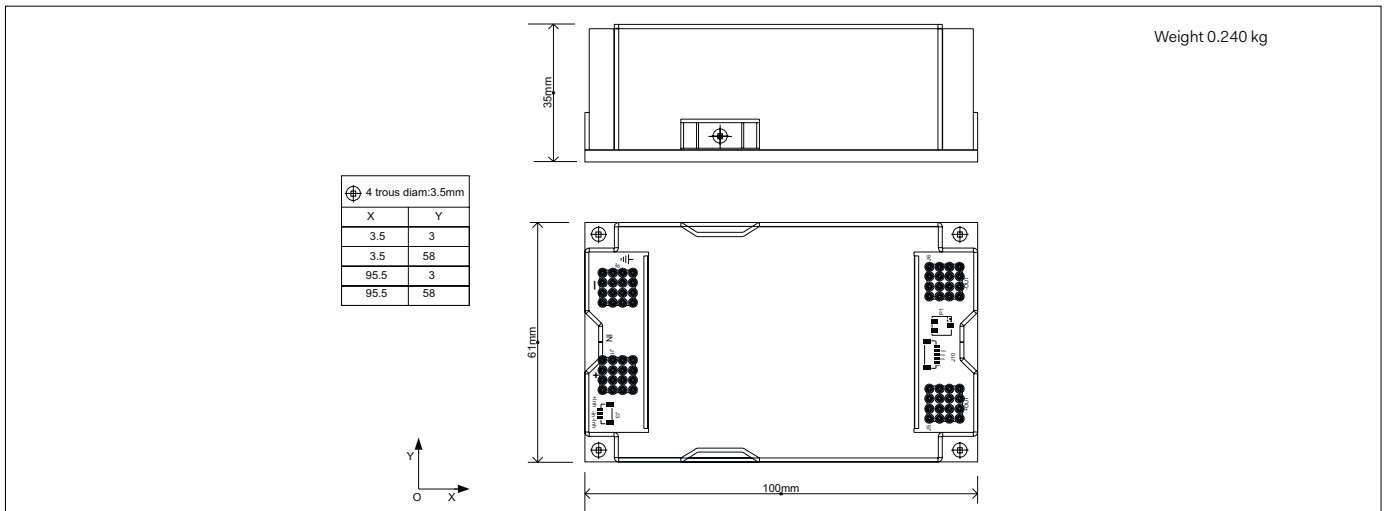
Mechanical DAA Series



Mechanical DAB Series

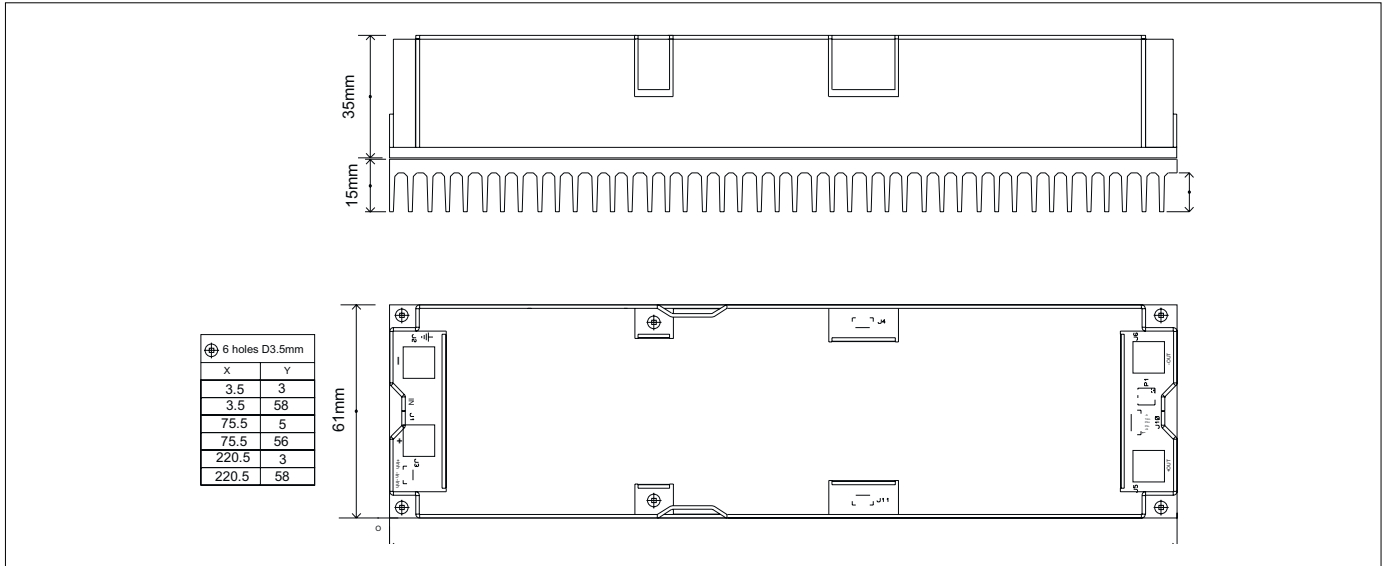


Mechanical DAC Series

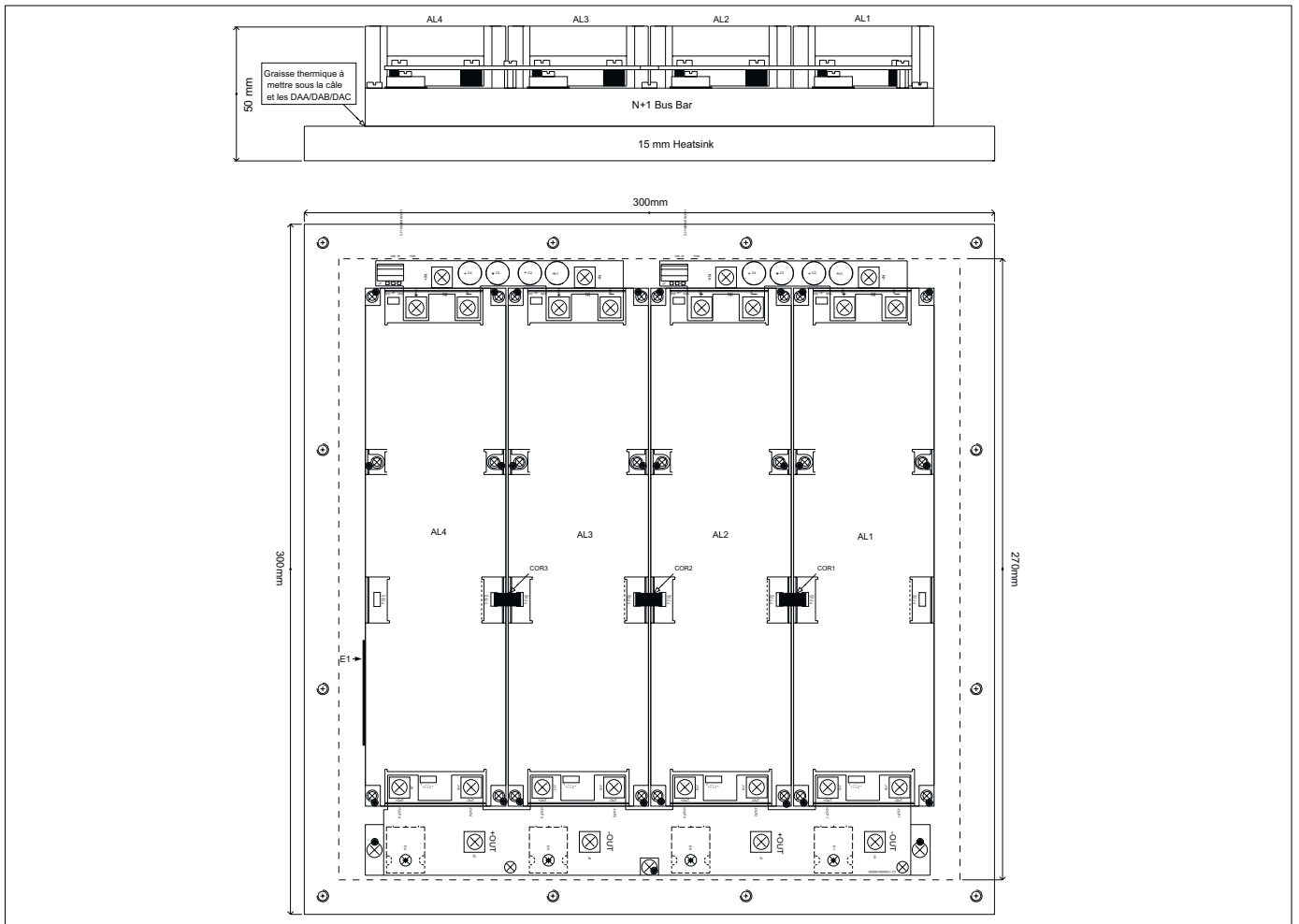


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 DAA/DAB/DAC Series
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 DC/DC Conduction Cooled
 Manual

H Option and Assembly Example
 DAA with H option



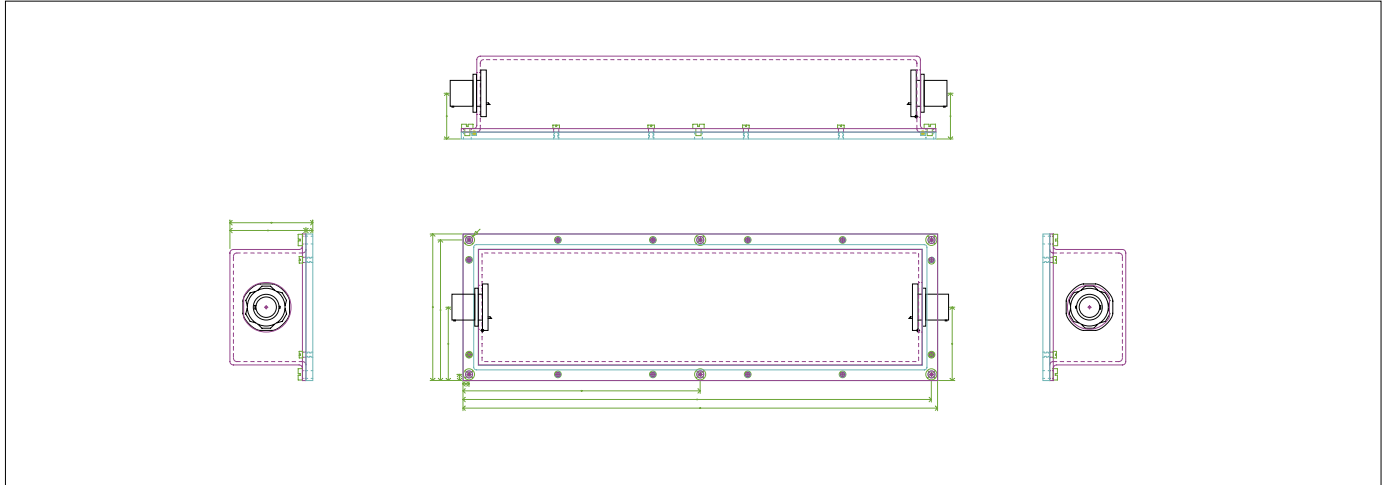
Assembly Example of DAA/DAB/DAC Series, 1500W, redundancy 3+1 mounted on heatsink for cabinet integration



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Manual

IP Format + Connector Pin Allocation

DAA with IP format



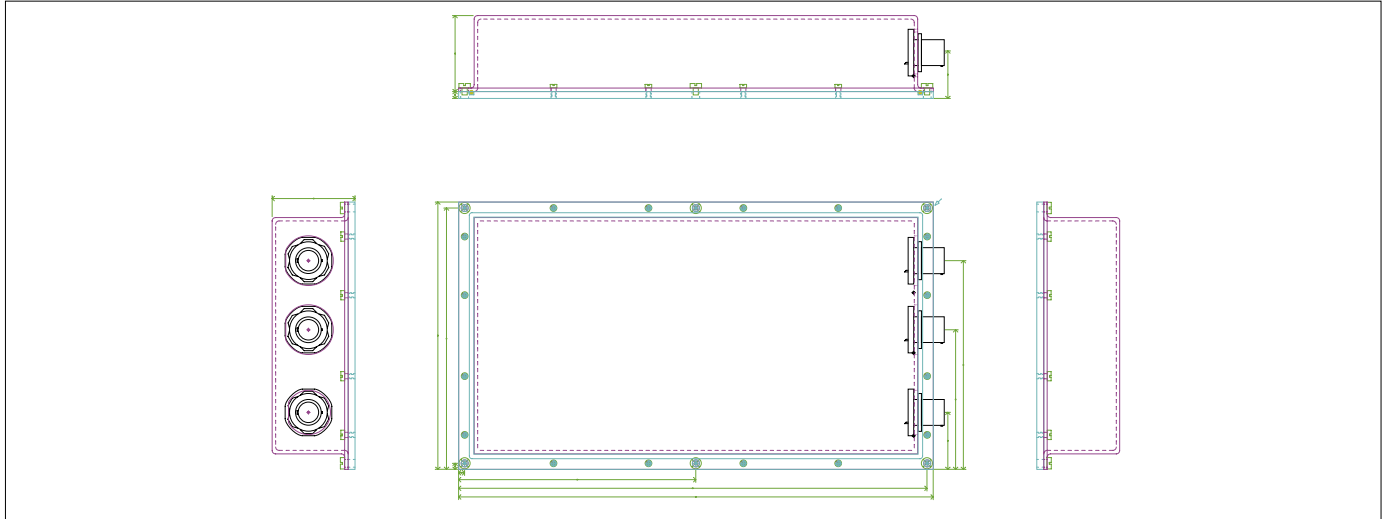
Connector Pin Allocation

Pin	Type	Pin	Description	Note
J1 INPUT	AMPHENOL Male 451 07A 168P 50 (mating 451 06A168S50)	A	INPUT +	
		B		
		C		
		D	INPUT -	
		E		
		F		
		G	Inhibit +	
		H	Inhibit -	
J3 OUTPUT	AMPHENOL Female 451 07A 1419S 50 (mating 451 06A 1419P 50)	A	OUTPUT +	All OUTPUT + pins should be connected together.
		B		
		C		All OUTPUT - pins should be connected together.
		D	OUTPUT -	
		E		
		F		
		G		
		H		
		J		
		K		
		L		
		M		
		N	Pgood +	
		P	Pgood -	
R				
S				
T	Sense +			
U	Sense -			
V	Adj			

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 DC/DC Conduction Cooled
 Manual

IP Format + Connector Pin Allocation

DAA with IP format

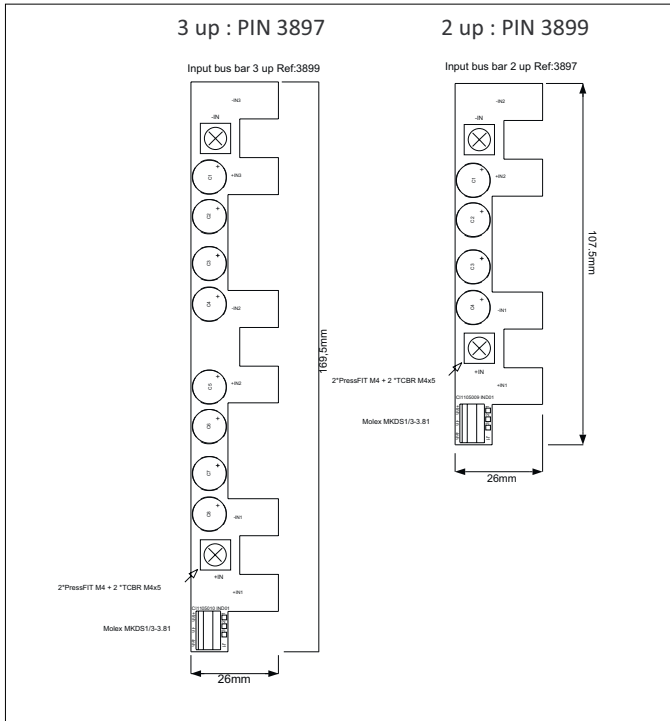


Connector Pin Allocation

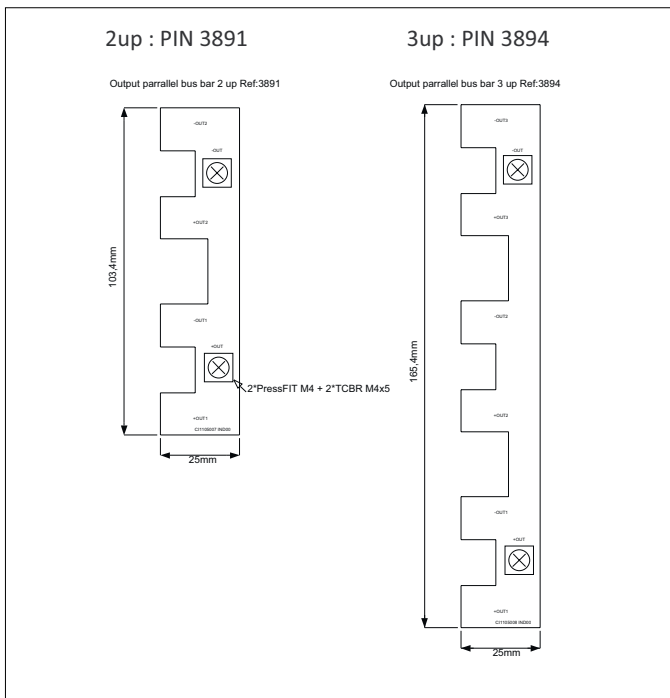
Pin	Type	Pin	Description	Note
J1 INPUT -	AMPHENOL Male 451 07A 168P 50 (mating 451 06A168S50)	A	INPUT -	8* pins for INPUT - (A, B, C, D, E, F, G, H) should be connected together.
		B		
		C		
		D		
		E		
		F		
		G	Inhibit +	
		H	Inhibit -	
J2 INPUT +	AMPHENOL Female 451 07A 168S 50 (mating 451 06A 168P 50)	A	INPUT +	8* pins for INPUT + (A, B, C, D, E, F, G, H) should be connected together.
		B		
		C		
		D		
		E		
		F		
		G	PR +	
		H	PR -	
J3 OUTPUT	AMPHENOL Female 451 07A 1419S 50 (mating 451 06A 1419P 50)	A	OUTPUT +	All OUTPUT + pins should be connected together.
		B		
		C		All OUTPUT - pins should be connected together.
		D		
		E		
		F		
		G	OUTPUT -	
		H		
		J		
		K		
		L		
		M-		
		N	Pgood +	
P	Pgood -			
R				
S				
T	Sense +			
U	Sense -			
V	Adj			

Accessories Data

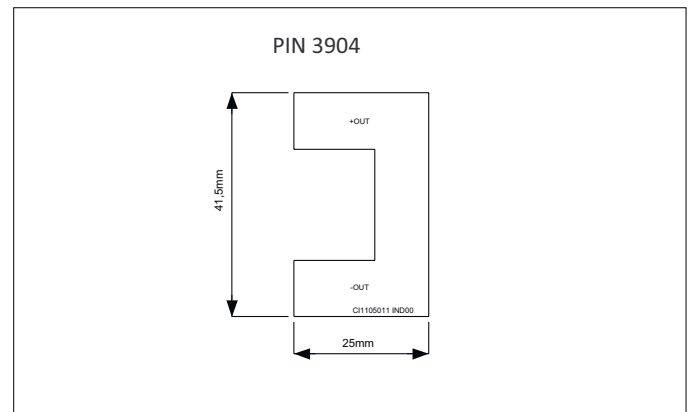
Input Bus Bar 2up & 3Up (footprint only for capacitors & screw connector)



Output Parallel Bus Bar

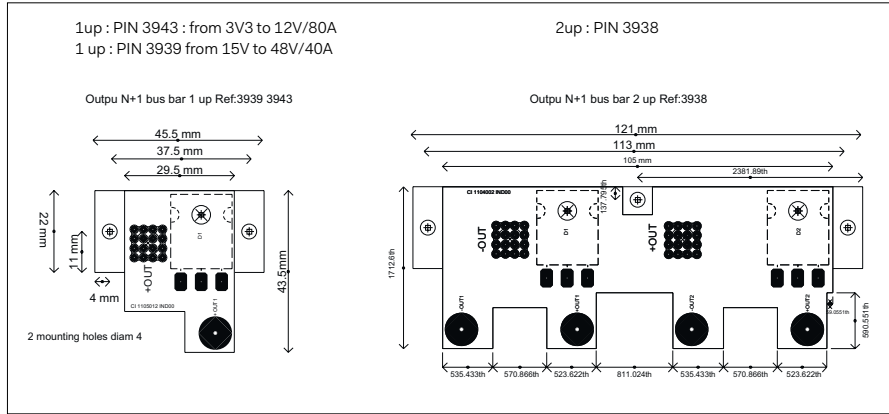


Output Serial Bus Bar

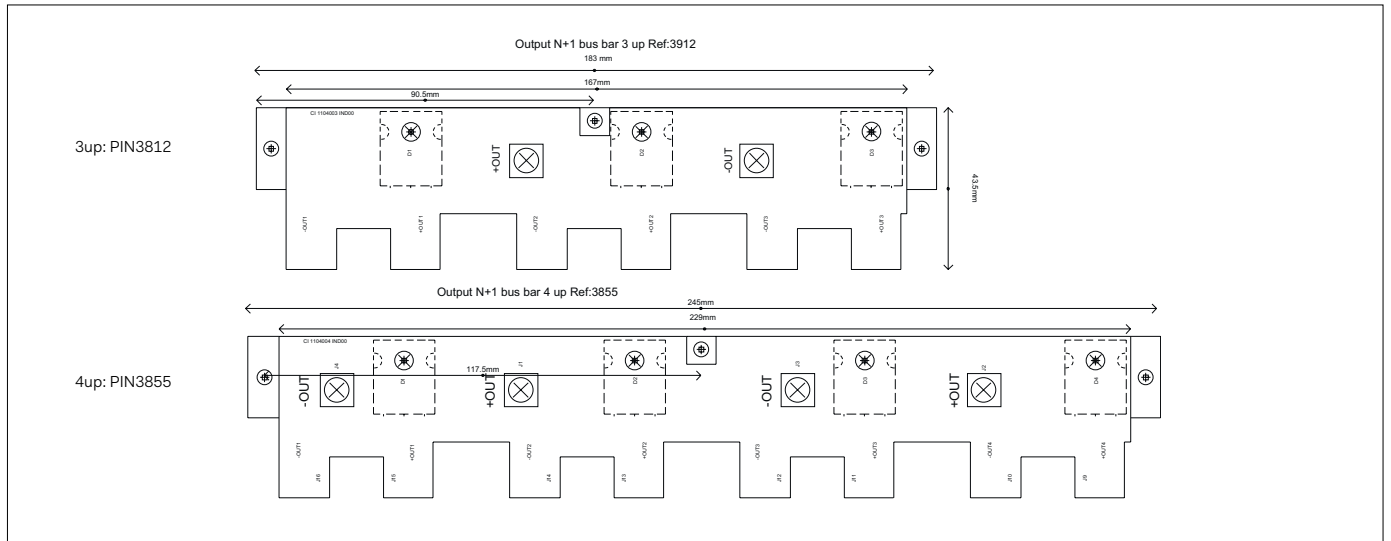


POWERBOX Defense Line
 DAA/DAB/DAC Series
 150W to several kW
 DC/DC Conduction Cooled
 Manual

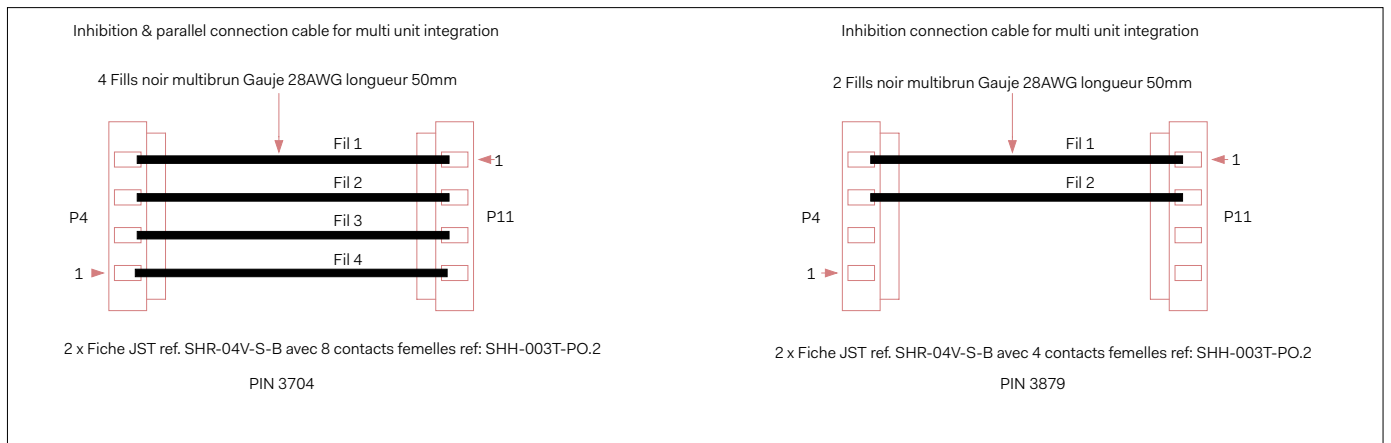
Output N+1 Bus Bar



Output N+1 Bus Bar



Cables



POWERBOX Defense Line
DAA/DAB/DAC Series
150W to several kWs
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Manual

Options and Configurations

DAA: M-module

DAA	Vin	Vout	Pout	Option	Format
				H : Heatsink	IP: IP65
				M : Ruggedized	chassis mount
				R : N+1 for all outputs	
				T : -40°C	
				V : Conformal coating	

For multiple combination of the same package, use P/N as follows.
Units will be delivered with accessories mounted (Bus bar for parallel & serial , N+1).

Example:

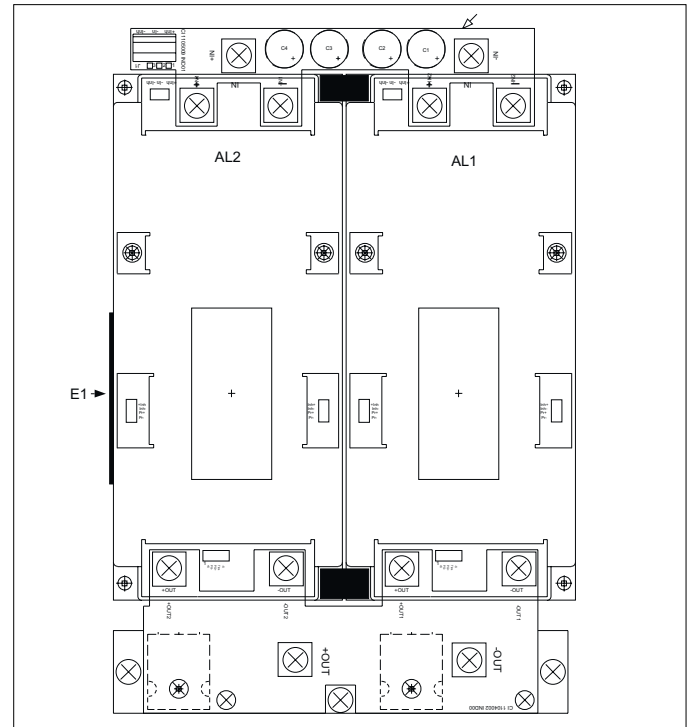
2up 2 outputs	DAA Vin -V1P1-V2P2- O-F	
2up 1 output	DAA Vin -V1P- O-F	1 output of P1+P2 where P1=P2 (do not put in parallel 2 different power)
3up 3 outputs	DAA Vin -V1P1-V2P2-V3P3- O-F	
3up 2 outputs	DAA Vin -V1P-V2P2- O-F	(P = 2 x P1)
	DAA Vin -V1P1-V2P2- O-F	

Option

- H : Heatsink
- M : Ruggedized
- P1 : Parallel V1 & V2
- P2 : Parallel V2 & V3
- R : N+1
- R1 : N+1 V1 & V2
- R2 : N+1 V2 & V3
- S1 : Serialized V1 & V2
- S2 : Serialized V2 & V3
- T : -40°C
- V : Conformal coating

Format

IP: IP65 chassis mount



POWERBOX Defense Line
 DAA/DAB/DAC Series
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 Manual

Options and Configuration

DAB: m-module

DAB	Vin	Vout	Pout	Option	Format
				H : Heatsink	IP: IP65
				M : Ruggedized	chassis mount
				R : N+1 for all outputs	
				T : -40°C	
				V : Conformal coating	

For multiple combination of the same package, use P/N as follows.
 Units will be delivered with accessories mounted (Bus bar for parallel & serial , N+1).

Example:

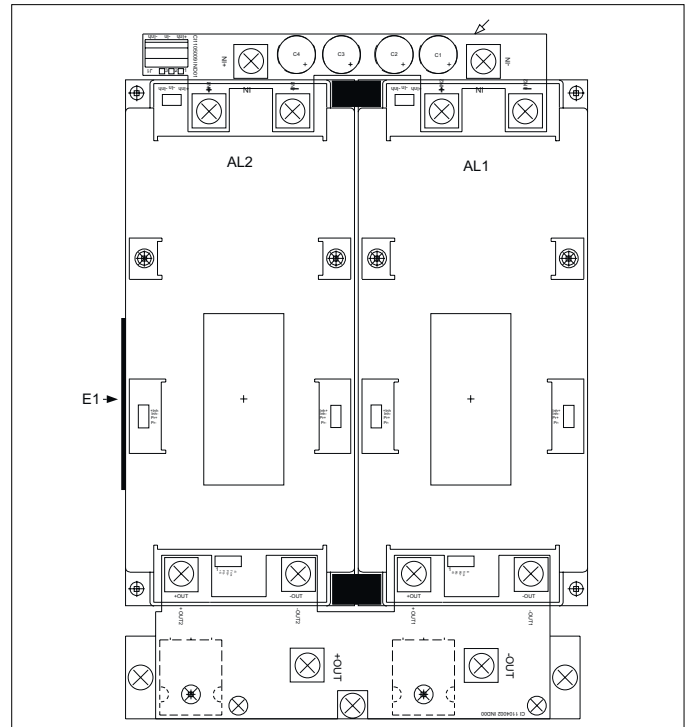
2up 2 outputs	DAB Vin -V1P1-V2P2- O-F	
2up 1 output	DAB Vin -V1P- O-F	1 output of P1+P2 where P1=P2 (do not put in parallel 2 different power)
3up 3 outputs	DAB Vin -V1P1-V2P2-V3P3- O-F	
3up 2 outputs	DAB Vin -V1P-V2P2- O-F	(P = 2 x P1)
	DAB Vin -V1P1-V2P2- O-F	

Option

- H : Heatsink
- M : Ruggedized
- P1 : Parallel V1 & V2
- P2 : Parallel V2 & V3
- R : N+1
- R1 : N+1 V1 & V2
- R2 : N+1 V2 & V3
- S1 : Serialized V1 & V2
- S2 : Serialized V2 & V3
- T : -40°C
- V : Conformal coating

Format

IP: IP65 chassis mount



POWERBOX Defense Line
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Options and Configuration

DAC: M-module

DAC	Vin	Vout	Pout	Option	Format
				H : Heatsink	IP: IP65
				M : Ruggedized	chassis mount
				R : N+1 for all outputs	
				T : -40°C	
				V : Conformal coating	

For multiple combination of the same package, use P/N as follows.
 Units will be delivered with accessories mounted (Bus bar for parallel & serial , N+1).

Example:

2up 2 outputs	DAC Vin -V1P1-V2P2- O-F	
2up 1 output	DAC Vin -V1P- O-F	1 output of P1+P2 where P1=P2 (do not put in parallel 2 different power)
3up 3 outputs	DAC Vin-V1P1-V2P2-V3P3- O-F	
3up 2 outputs	DAC Vin-V1P-V2P2- O-F	(P = 2 x P1)
	DAC Vin -V1P1-V2P2- O-F	

Option

- H : Heatsink
- M : Ruggedized
- P1 : Parallel V1 & V2
- P2 : Parallel V2 & V3
- R : N+1
- R1 : N+1 V1 & V2
- R2 : N+1 V2 & V3
- S1 : Serialized V1 & V2
- S2 : Serialized V2 & V3
- T : -40°C
- V : Conformal coating

Format

IP: IP65 chassis mount

