P-DUKE®

P-DUKE POWER

Railway Power Solution
Brochure

Searching the RIGHT

POWER SOLUTION

Only P-DUKE

IEC 60950-1 | IEC 62368-1 | EN 50155 : 2017 | EN 45545-2 | EN 61373

Who We Are

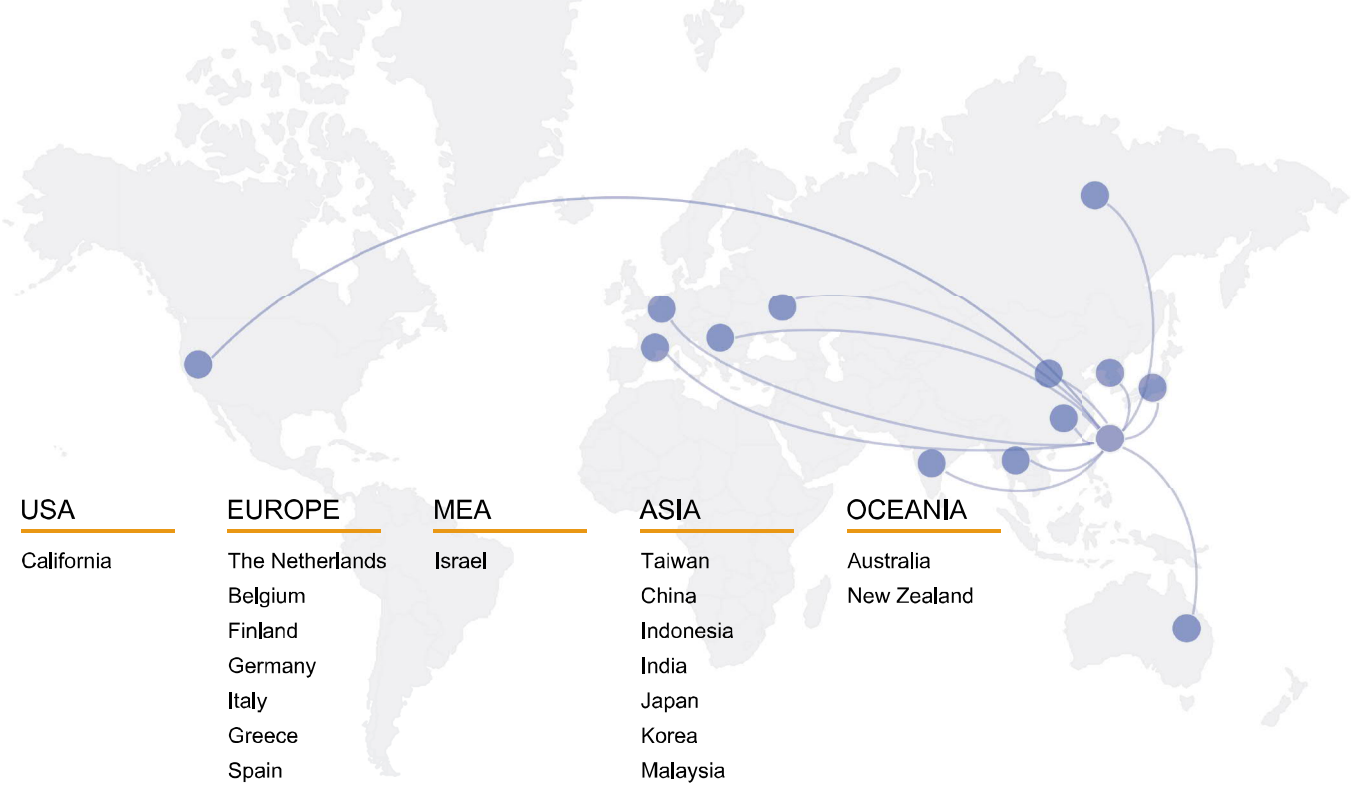
Founded in 1992, P-DUKE 100% concentrated on the research, development, production, sales and service of DC/DC Converters and related products. With products sold under our own brand name, P-DUKE to Europe, America, and Japan, we accumulate great skills through years of experience and open up better product awareness which leads to further cooperation with world-famous companies, making P-DUKE an important role in the global market.

3S Commitment: A Full Range of Services

Through multiple methods, P-DUKE keeps following up the ever-changing pulse of power industry, and performs our 3S commitments to the highest. We provide a full range of product line, from standard types to customized products. Even the application engineering service of the final product systems is also our forte.What we have and what we do is exactly what you need, and this is why P-DUKE makes an irreplaceable role among customers and partners.

Global Logistic, Local Management

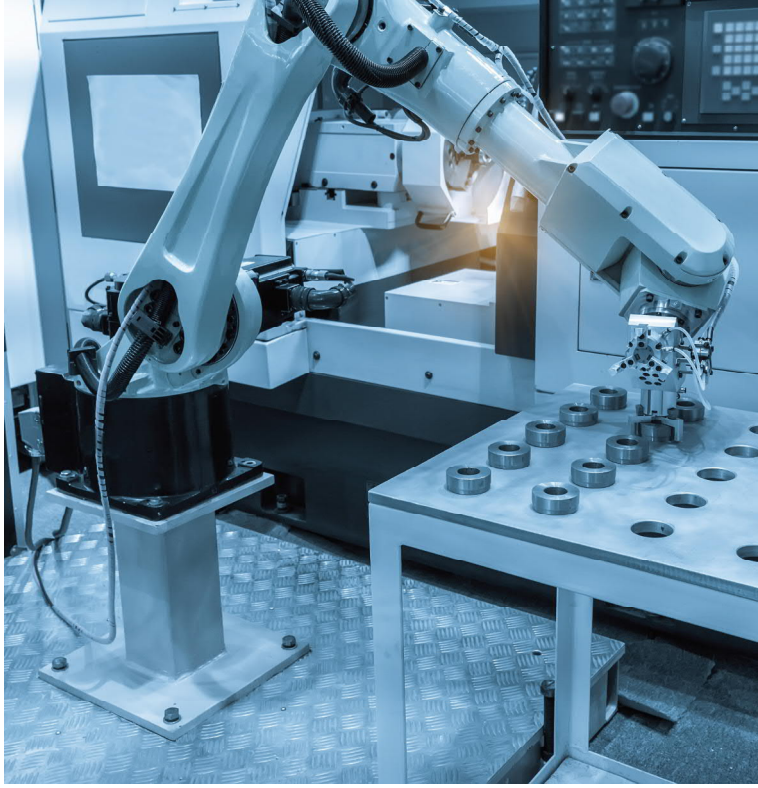
We expand our own brand, P-DUKE through various marketing channels to construct a worldwide network. Apart from stabilizing the existing markets,P-DUKE operates strategy management on Niche markets by changing from distribution to local direct selling.
With the faith we hold, “Global Logistic, Local Management”, we’ll keep pushing new innovations toward power modules and therefore creating a full range of product line.



USA	EUROPE	MEA	ASIA	OCEANIA
California	The Netherlands	Israel	Taiwan	Australia
	Belgium		China	New Zealand
	Finland		Indonesia	
	Germany		India	
	Italy		Japan	
	Greece		Korea	
	Spain		Malaysia	
	Portugal			
	Sweden			
	Switzerland			
	UK			
	Russia			

P-DUKE has been respecting and emphasizing the importance of Intellectual Property Rights. We have obtained multinational patents so far. To all the advanced companies in this industry, do not violate our Intellectual Property. Once any enterprises or individuals are found guilty of the infringement of intellectual property rights may be subject to investigate. P-DUKE has the right to protect our customers and be responsible for shareholders' equity.

P-DUKE’s patents include the following: US 7,894,214 B1, US 8,817,495 B2, Nr. 20 2010 006 407.4, ZL 2011 2 C088132.5 ...



Power the World, the Innovator of Power Solutions

P-DUKE devotes a lot of efforts in nurturing research staffs. We introduce latest technology skills along with the research instrument and CAD to our factory, making our researches to reach the world-class level.

We've acquired ISO 9001 Quality Management System certification, and safety approval of UL and CE. Our products own many design and manufacturing process patents, and our medical product even won the Innovation Award of TAITRONICS in 2014 and 2015.

P-DUKE has an excellent R & D team. In addition to develop products of high power density and green concept, we also put efforts on researches and developments for multiple kinds of products in order to enhance the completeness of the product specification.

In this challenging environment of railway. We provide power solutions from 3 to 300 watts of DC/DC converters. They are designed for railway applications and the non-controllable environment. Including unstable input voltage, variable ambient temperature, vibration, mechanical shock and input surge voltage. EN50155 is the basic requirement for railway application but must be approved.

P-DUKE POWER has engaged in developing DC/DC converters for over 26-year, with abundant experience and of knowledge in railway, we can provide the best solution for our customers. It is important to choose an appropriate part for railway application. These modules need to be high reliability and longevity in order to make sure the passengers are safe. P-DUKE's power solutions have been approved by transportation in worldwide.

Our Strength

26-Year experience

Reliable Products

High Efficiency

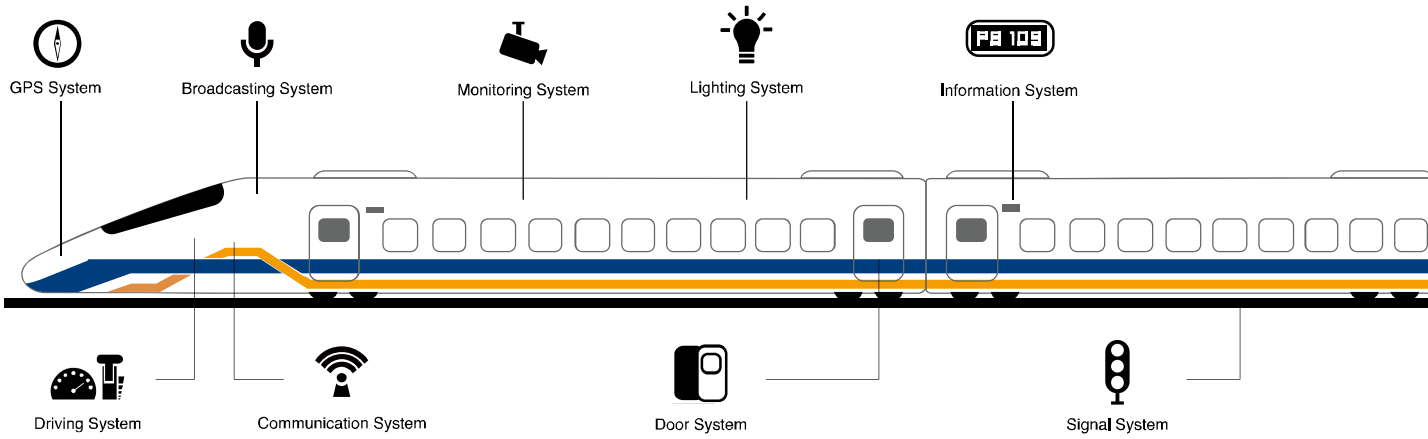
Customized Products

excellent Service

Applications

P-DUKE's railway applications DC/DC converters all have been approved by the following safety and standards.

IEC/ UL/ EN 60950-1	Information Technology Equipment Safety
IEC/ UL/ EN 62368-1	Audio/ Video, Information Technology and Communication on Technology Equipment
EN 50155	Electronic Equipment Used on Rolling Stock
EN45545-2	Fire Testing to Railway Components



P-DUKE sells our products via authorized distributors worldwide. We have many successful railway projects in France, China, Spain, Italy, India and Taiwan.

Serving customers is always the first thing to us. We are rich in the experience and knowlege on all kinds of applications of rolling stock. We cooperate with customers, offer the technology and service as we can to help customers run the project smoothly.

Requirements of EN50155

Ambient Temperature

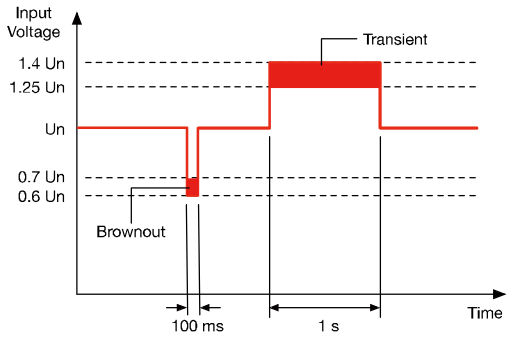
According to the table shown as below required by EN50155, the power module needs to be designed to meet the requirements of surrounding environment and make sure temperature of the power module under the maximum rating.

Class	Equipment Operating Temp. Range (°C)
OT1	-25 to +55
OT2	-40 to +55
OT3	-25 to +70
OT4	-40 to +70
OT5	-25 to +85
OT6	-40 to +85

Class	Extended Operating Temp. Range	Thermal Test Cycle
ST0	No switch-on extended temp. range	Test cycle A
ST1	OTx + 15°C	Test cycle B
ST2	OTx + 15°C	Test cycle C

Variable Input Voltage

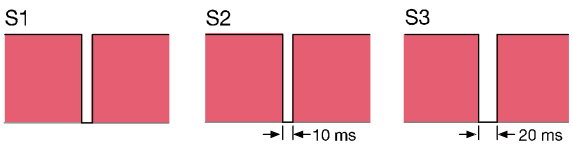
There are several battery systems in railway application. Those are 24, 28, 36, 48, 72, 96, 110VDC. But the input voltage is not stable when the system is operating. It needs to cover 0.6Un brownout and 1.4Un transient. A power module is better to be designed to cover the input range from 0.6Un to 1.4Un.



Ultra-wide Input Range Model	4:1 Input Range Model	System Un	Brownout 0.6xUn	Transient 1.4xUn
__-72xxxU 14-160V	__-24xxxW 9-36V	24V	14.4V	33.6V
		28V	16.8V	39.2V
	__-48xxxW 18-75V	36V	21.6V	50.4V
		48V	28.8V	67.2V
	__-110xxxW 43-110V	72V	43.2V	100.8V
		96V	57.6V	134.4V
		110V	66V	154V

Supply Voltage Interruptions and Change Over

Interruption-
Due to a short circuit on a DC supply distribution line and subsequent operation of fuse/ circuit breakers, input voltage may reduce to 0 V for a short period.



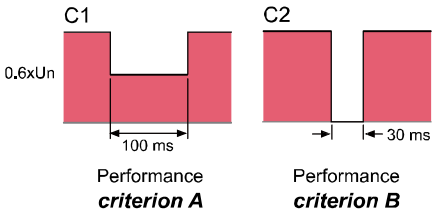
No performance criterion is requested but the equipment shall continue to operate as specified after the voltage interruption.

Default condition Performance ***criterion A***

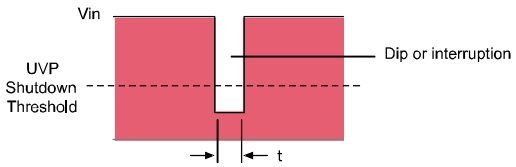
Performance ***criterion A***

Requirements of EN50155

Change over-
When the equipment supply is switched between different sources.



The default conditions are S2 and C1. Normally, modules can meet C2 condition stand-alone. But to pass S2, S3 or C2 of requirement will need quite many number aluminum electrolytic capacitors to keep the power during interruption. The capacitance can be calculated by the following equation.



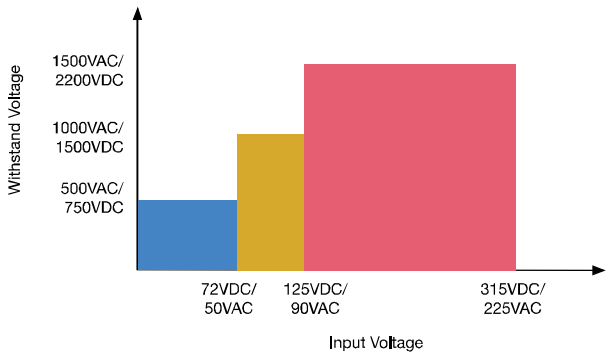
$$C_{in,\ Hold\text{-}up} = \frac{2 \times P_{in} \times t}{V_{in}^2 - V_{UVP}^2} \times 1.5$$

Isolation Voltage

According to EN50155, there is a basic requirement for isolation voltage between input and output.

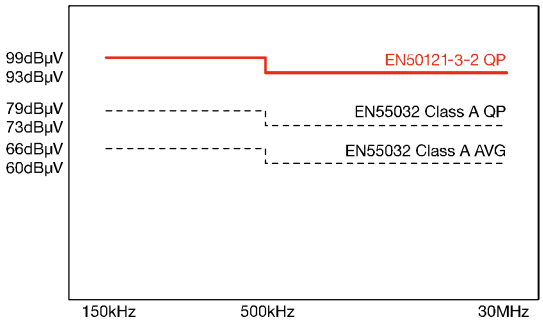
Un < 72: 500VAC
72VDC ≦ Un < 125VDC: 1000VAC
125VDC ≦ Un < 315VDC: 1500VAC

where Un is Battery system

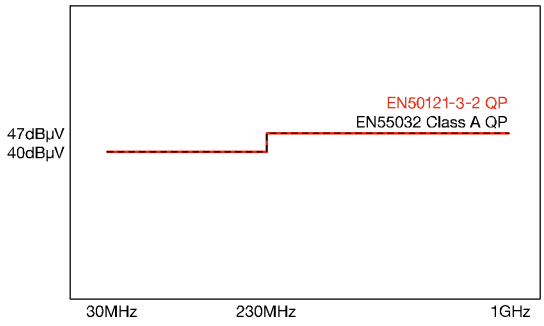


EMC

Here shows the limit lines of conducted and radiated emission.
All of our products can meet EN55032 Class A with or without external components. P-DUKE can offer you a detail EMI solution on each product. We also have the ability on solving variety issues in all kinds of applications.



Conducted Emission



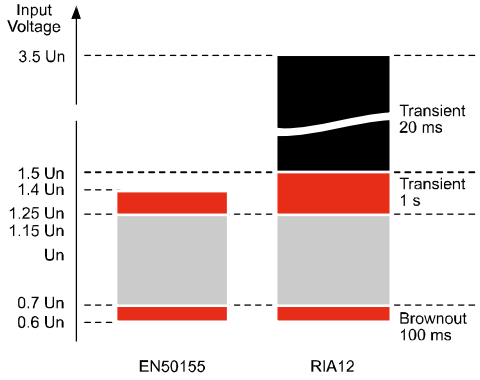
Radiated Emission

Performance criteria requirements of EMS test.

Parameter	Basic Standard	Conditions	Performance criteria
ESD	EN61000-4-2	Air: ± 8kV Contact: ± 6kV	B
Radiated Immunity	EN61000-4-3	20V/m	A
Fast Transient	EN61000-4-4	± 2kV	A
Surge	EN61000-4-5	Line-Gnd: ± 2kV Line-Line: ± 1kV	B
Conducted Immunity	EN61000-4-6	10V/m	A

RIA12

According to standard RIA12, there is input surge requirement which is 3.5 times of supply voltage with 20ms duration.
In the situation when input voltage is110V, the surge voltage would be 385V. It is impossible to absorb by using capacitor or TVS for this high energy.
To protect DC/DC modules, external active circuits are necessary and the modules should keep operating during surge occurs.
The external circuit needs to clamp the voltage into a safe level for power modules.
But it is always not easy to find suitable components or optimize circuits to help this situation.

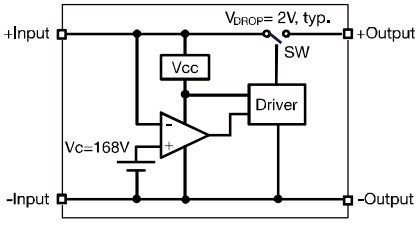


System Un	Input Range 0.7xUn - 1.25xUn	Brownout 100ms 0.6xUn	Transient 1 sec. 1.4xUn	Transient 20ms 3.5xUn
72V	50.4 - 90V	43.2V	108V	252V
96V	67.2 - 120V	57.6V	144V	336V
110V	77 - 137.5V	66V	165V	385V

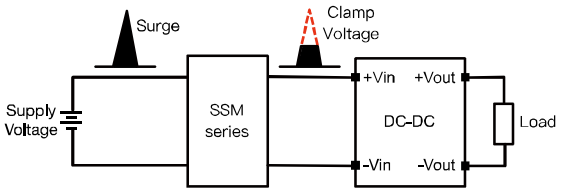
RIA12 Standard

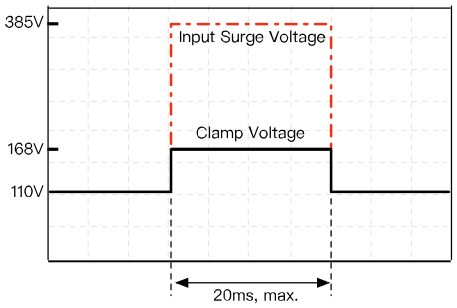
Function of SSM Series

Reducing input power is a way to protect DC/DC module when surge occurs. But it is not enough to meet requirements of RIA12 or others and it doesn't allow power to shutdown.



SSM series is a perfect solution for RIA12 surge protection. Its biggest feature is to clamp surge voltage.
When input surge voltage is over 168V, the SSM module will start absorbing the exceeding energy from surge.
It can help maintaining input voltage to DC/DC module at 168V during the situation. So the input voltage will not damage DC/DC module and also keep it working normally.



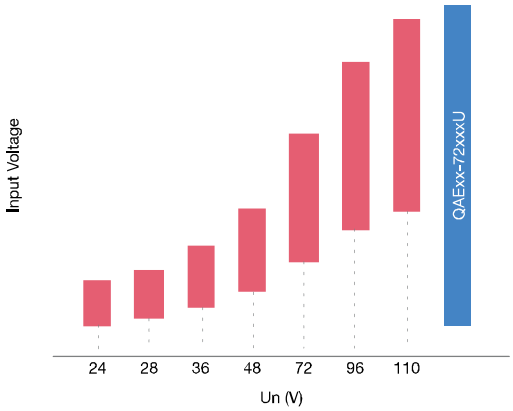


- There is typical 2V voltage drop between +Input and +Output and it's caused by SW.
- Maximum Rating of input voltage is 385V for 50ms.
- Output voltage will maintain 168V (typical) when input voltage exceeds 168V.

Typical Application of QAExxU series

12:1 Ultra-wide Input Range

QAExxU-K are the series which feature ultra-wide input range. They could cover all the input range of railway applications easily.

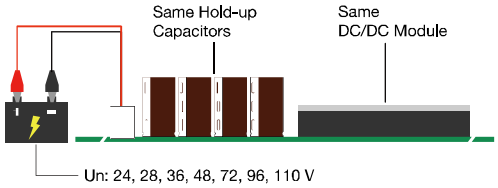


Benefits from QAExxU-K

- One set of Hold-up capacitors can be used for all systems.
- Simplify using 25V withstand capacitor
- Reduce size of Hold-up capacitors
- Reduce cost of capacitors
- Lower Inrush current

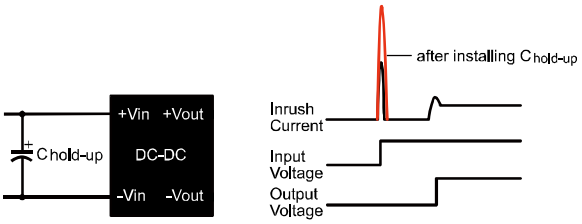
Enhanced Hold-up Function

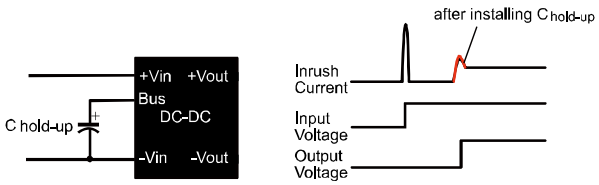
Generally, to pass this kind of requirement will need quite many number aluminum electrolytic capacitors to keep the power during interruption. Also these capacitors need a lot of space, and not easy to choose, especially to high withstand voltage capacitor. QAExxU-K product is designed to cover all battery systems. The purpose is to help customers when design a power system can use only one single solution to deal with all power systems. Besides no need to change power module, but also no need to adjust hold-up capacitor integrated solution.



Inrush Current Limit

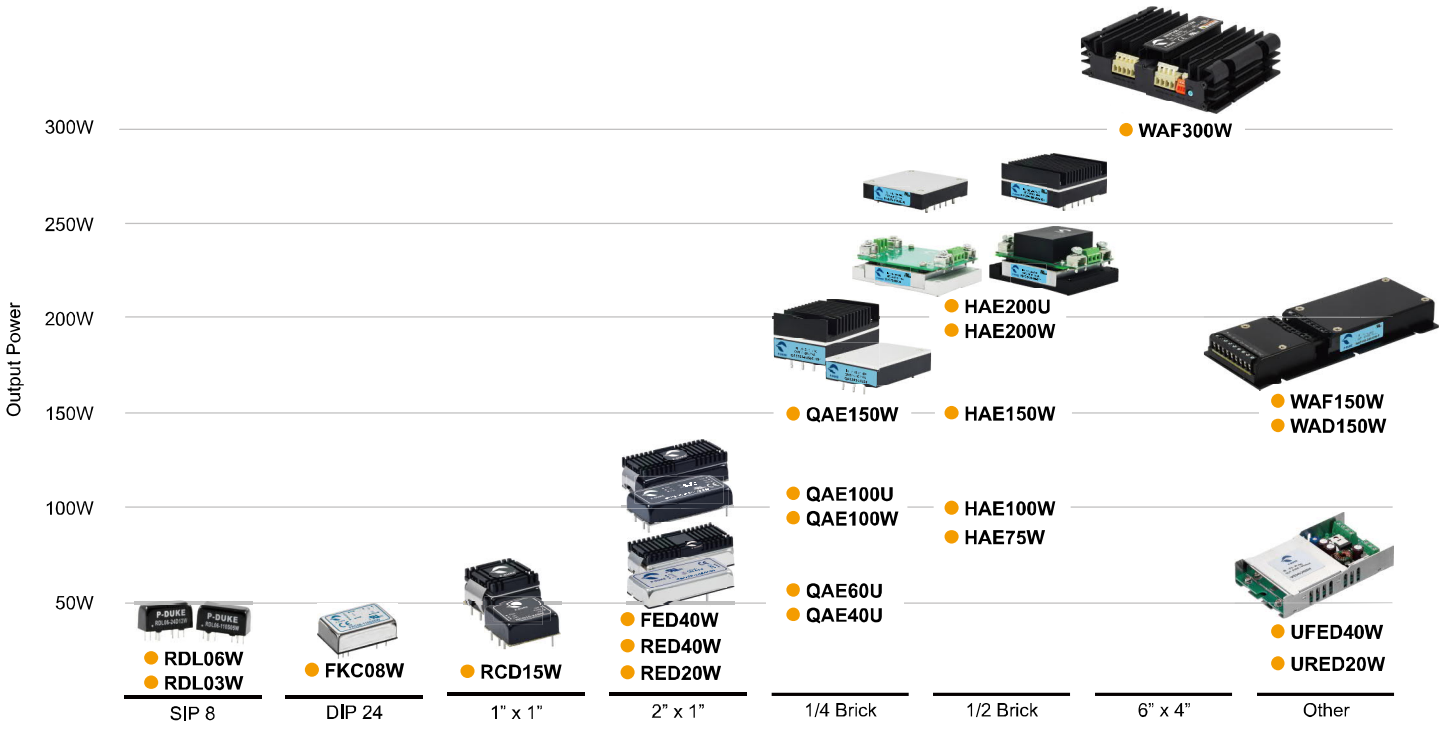
There is one thing that engineers should take into consider is the inrush current. In order to meet the requirements of supply interruption, it's necessary to put capacitors on the input if the module doesn't have Bus pin. When it applies supply voltage, the capacitors are charged by supply voltage. That causes high inrush current and may lead to some abnormal circumstance. Generally, people would choose to add extra circuit for inrush limitation. But our –K option is built-in an internal current limit circuit that can offer a constant current to charge capacitors. It will save space and cost from adding external inrush limit circuit.





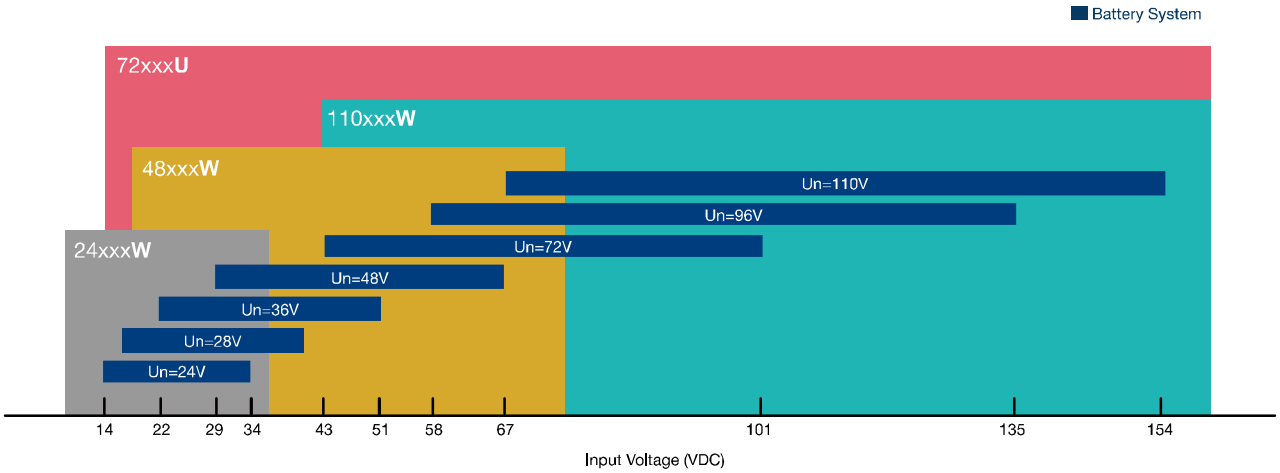
DC/DC Converters for Railway Application

P-DUKE provides 3-300W DC/DC, and many different kinds of package to meet different space and installation requirement in railway application product line.

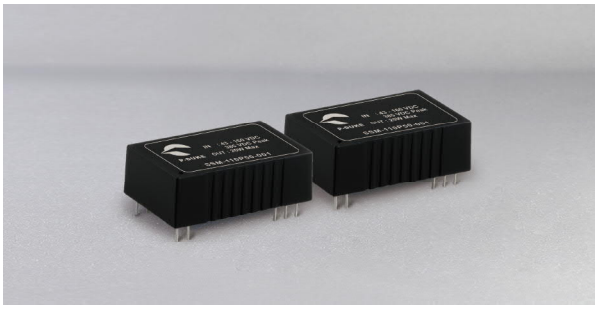


Model Selection for Specified Un

From the graph under, we can find different product part numbers to go with different Un system. For example, 48xxxW can cover Un=36V&48V.
The last letter W means 4:1 input voltage range. Also we can use a single DC/DC converter to cover all Un system, which is QAE60U series, the input voltage range is 10:1. Part number is QAE60-72SxxU.



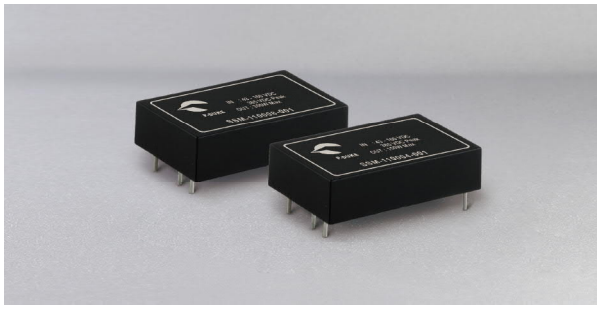
Railway Product Line



SSM-110P50-001

20 Watts | Surge Suppression Module

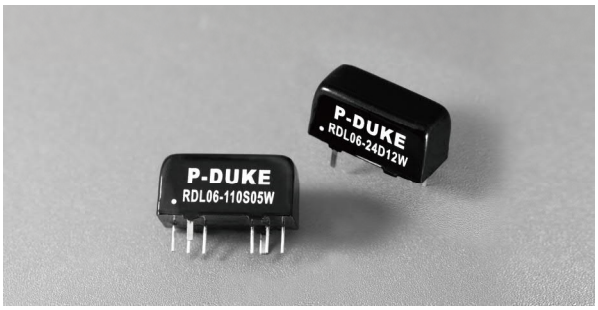
- Input Voltage : 43-160 VDC
- Transient Voltage : 385 VDC, 20 ms, max.
- Meet RIA12 Surge Susceptibility NF F 01-510
- Through Hole Type
- DIP 24 Type



SSM-110004-001 | SSM-110008-001

150-300 Watts | Surge Suppression Module

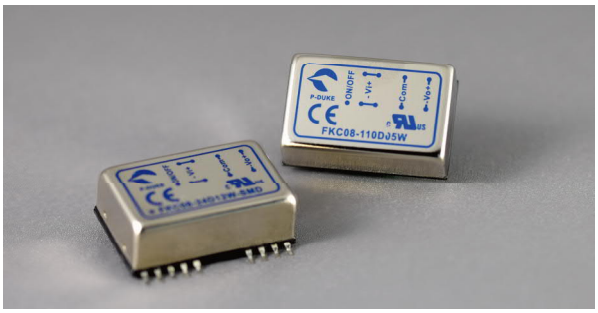
- Input Voltage : 43-160 VDC
- Transient Voltage : 385 VDC, 20 ms, max.
- Meet RIA12 Surge Susceptibility NF F 01-510
- Through Hole Type
- Standard 1.6"x1" Package



RDLxxW series NEW

3 Watts to 6 Watts | DC-DC

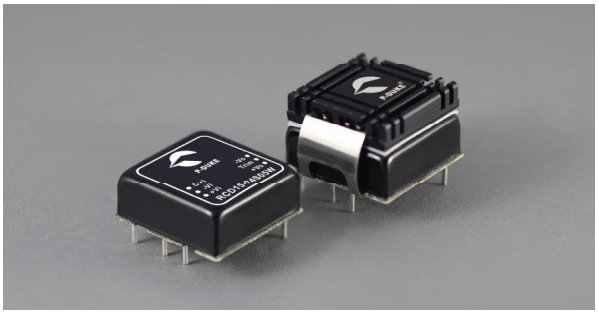
- 4:1 Input Voltage：9-36, 18-75, 43-160 VDC
- Output Voltage：3.3, 5, 9, 12, 15, 24, ±5, ±12, ±15 VDC
- Up To 3000VDC Isolation Voltage
- Through Hole Type
- Standard SIP 8 Package



FKC08W series

8 Watts | DC-DC

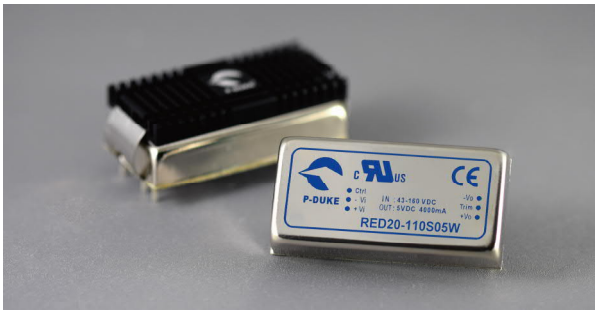
- 4:1 Input Voltage : 9-36, 18-75, 43-160 VDC
- Output Voltage：3.3, 5, 12, 15, ±5, ±12, ±15VDC
- 1600VDC Isolation Voltage
- SMD and DIP 24 Type



RCD15W series NEW

15 Watts | DC-DC

- 4:1 Input Voltage : 9-36, 18-75, 36-160 VDC
- Output Voltage : 3.3, 5, 12, 15, 24, ±5, ±12, ±15, ±24 VDC
- Built-in EN55032 EMI Class A Filter
- Up To 3000VDC Isolation Voltage
- Allow Operating Under -55℃ Ultra Low Ambient Temp.
- Through Hole Type
- Standard 1" x 1" Package



RED20W series

20 Watts | DC-DC

- 4:1 Input Voltage : 9-36, 18-75, 43-160 VDC
- Output Voltage : 3.3, 5, 12, 15, ±12, ±15 VDC
- Built-in EN55032 EMI Filter
- Up To 2250VDC Isolation Voltage
- Allow Operating Under -55℃ Ultra Low Ambient Temp.
- Through Hole Type
- Standard 2" x 1" Package

RED40W series NEW

40 Watts | DC-DC

- 4:1 Input Voltage：9-36, 18-75, 36-160 VDC
- Output Voltage：3.3, 5, 12, 15, 24, 48, 53, ±12, ±15, ±24 VDC
- Up To 3000VDC Isolation Voltage
- Allow Operating Under -55℃ Ultra Low Ambient Temp.
- Through Hole Type
- Standard 2" x 1" Package

FED40W series

40 Watts | DC-DC

- 4:1 Input Voltage : 9-36, 18-75, 43-160 VDC
- Output Voltage : 3.3, 5, 12, 15, 24, ±12, ±15, ±24 VDC
- Up To 3000VDC Isolation Voltage
- Allow Operating Under -55℃ Ultra Low Ambient Temp.
- Through Hole Type
- Standard 2" x 1" Package

URED20W series

20 Watts | DC-DC

- 4:1 Input Voltage : 9-36, 18-75, 43-160 VDC
- Output Voltage : 3.3, 5, 12, 15, ±12, ±15 VDC
- Built-in EN55032 EMI Class B Filter
- Built-in Inrush Current Limit Circuit
- Fuse Installed
- Up To 2250VDC Isolation Voltage
- Wall Mount and Din-rail Type

UFED40W series

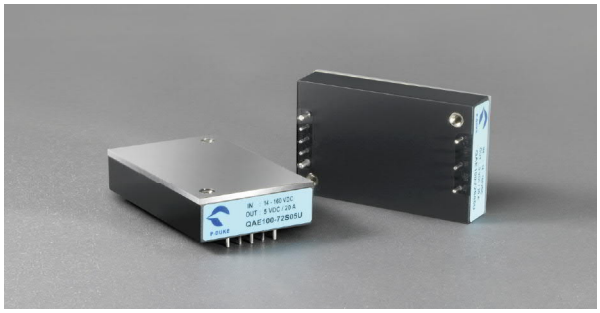
40 Watts | DC-DC

- 4:1 Input Voltage : 9.5-36, 18-75, 43-160 VDC
- Output Voltage : 3.3, 5, 12, 15, 24, ±12, ±15, ± 24 VDC
- Built-in EN55032 EMI Class B Filter
- Built-in Inrush Current Limit Circuit
- Fuse Installed
- Up To 3000VDC Isolation Voltage
- Wall Mount and Din-rail Type

QAE100 / 150W series

82 Watts to 132 Watts | DC-DC

- 4:1 Input Voltage：8.5-36, 16.5-75, 40-160 VDC
- Output Voltage：3.3, 5, 12, 15, 24, 30, 48 VDC
- Up To 3000VAC Isolation Voltage
- Through Hole Type
- Standard 1/4 Brick Package



QAE40/60/100U series NEW

40 Watts to 60 Watts | DC-DC

- 12:1 Input Voltage：9-75, 14-160 VDC
- Output Voltage：5, 12, 15, 24, 28, 48, 53 VDC
- Up To 3000VAC Isolation Voltage
- Through Hole Type
- Standard 1/4 Brick Package

Railway Product Line

HAE75 / 100 / 150 / 200W series

75 Watts to 240 Watts | DC-DC

- 4:1 Input Voltage：8.5-36, 16.5-75, 43-160 VDC
- Output Voltage：3.3, 5, 12, 15, 24, 28, 48 VDC
- Built-in EMI EN55032 Class A Filter with Wall Mount Type
- Up To 3000VAC Isolation Voltage
- Through Hole and Wall Mount Type
- Standard 1/2 Brick Package

HAE200U series NEW

200 Watts | DC-DC

- 10:1 Input Voltage : 16-160 VDC
- Output Voltage : 5, 12, 15, 24, 28, 48, 53 VDC
- Up To 3000VAC Isolation Voltage
- Through Hole and Wall Mount Type
- Standard 1/2 Brick Package

WAD150W / WAF150W series

150 Watts | DC-DC

- 4:1 Input Voltage：9-36, 18-75, 43-160 VDC
- Output Voltage：12, 15, 24, 28, 48 VDC
- Built-in EMI EN55032 Class A Filter
- Up To 2250VDC Isolation Voltage
- Reverse Polarity Protection
- Wall Mount Type

WAF300W series

300 Watts | DC-DC

- 4:1 Input Voltage：18-75, 43-160 VDC
- Output Voltage：12, 15, 24, 28, 48 VDC
- Built-in EMI EN55032 Class A Filter
- Up To 3000VAC Isolation Voltage
- Current Share Function
- Wall Mount and Din-rail Type

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