Technical Note

Multi-Stage Surge Protection

ACDC Surge Protectors Type -PS (11; 137; 146)-M Orange Series

EIGHT (8) STAGES SERIES PROTECTOR 1/1

Single Phase CLASS I+II+III

Plug in Installation - SCHUKO PLUG

- **Cascade bi-directional EMI-RFI filtering of phase (L) and neutral (N) wire**
- **Indication for bed grounding**

Type - PS (11; 137; 146)-M Orange Series

Metal Enclosures

Schuko plug
F-type

Product manufacture by

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1. Introduction

This paper is summarizing the advantages of ACDC Surge Protectors and recent changes in approach of the Surge protection technology. That implies implementation of new methods, new materials and new design for surge protection of electrical devices which represent a significant improvements in this area.

Lightning strikes, dangerous surges and transients induced by lightning, as well as surges caused by motor switching and power supply regulation problems are direct threat to people, building facilities, electrical and electronic equipment.

No single technology can effective protected from the damaging effects of lightning and induced transients, which can severely damage or destroy electronic systems.

Our concept of Multi-Stage surge protection consist of eight (8) protection stages in one compact unit. The products ACDC Surge Protector have built-in 5 (five) innovations (patents) and present a new advance surge protection design.

In order to provide the optimum level of protection, ACDC DCAC has developed new integrate 8 (eight) stages surge protector that provides effective and reliable protection against surges and transients. Our approach include integration of suppressors in compact multi-stage protection unit, new filtering design, option for ground filtering and new diagnostics system.

The ACDC Surge Protectors have coordinated approach to lightning protection, surge and transient protection as well as grounding, an approach that embraces all aspects of potential damage. This integrated protection designs are equipped with significantly more features and provide a higher level of performances.

The needs of this kind of coordinated integrate multi-stage surge protection is obvious with appearing of new more sophisticate electrical equipment and in the same time more sensitive on power supply sags, black outs, induced voltage spikes...

The approach to integrated multi-stage surge protection system, significantly reduces the Total Cost* and presents excellent choice for investment in the quality of power supply.

2. Application Guide

Application: Multi-stage surge protectors from Orange Series have been developed specially to protect and improve functioning of electronic devices from nonstandard over-voltage conditions high-frequency (electromagnetic) disturbance, oscillations, transients, speaks in power grid and atmospheric discharge.

ACDC Surge protectors have high-grade cascade bidirectional filtering. They are tracking AC waveform eliminating so-called pollution in power AC supply.

ACDC Surge Protector - Orange Series is compact stand alone unit. It is install quickly and easily to standard electrical outlets on principle PLUG and PLAY. The units could be use for protection of one electronic device or group electronic devices thought power strip up to load of 25A per phase.

The ACDC Surge Protectors - Orange Series have cascade EMI-RFI filtering of phase and neutral wire that provide reliable protection toward all kind of surges and transients.

The ACDC Surge Protectors - Orange Series completely eliminates frequency noise and power pollution generated in power network supply.

This pollution equals losses, unreliable performance, decrease asset life-spans, increase maintenance and downtime. These protectors have special design to protect and improve functioning of sophisticate equipment in Telecommunications, Computers, Medical equipment, Military, Home and other.

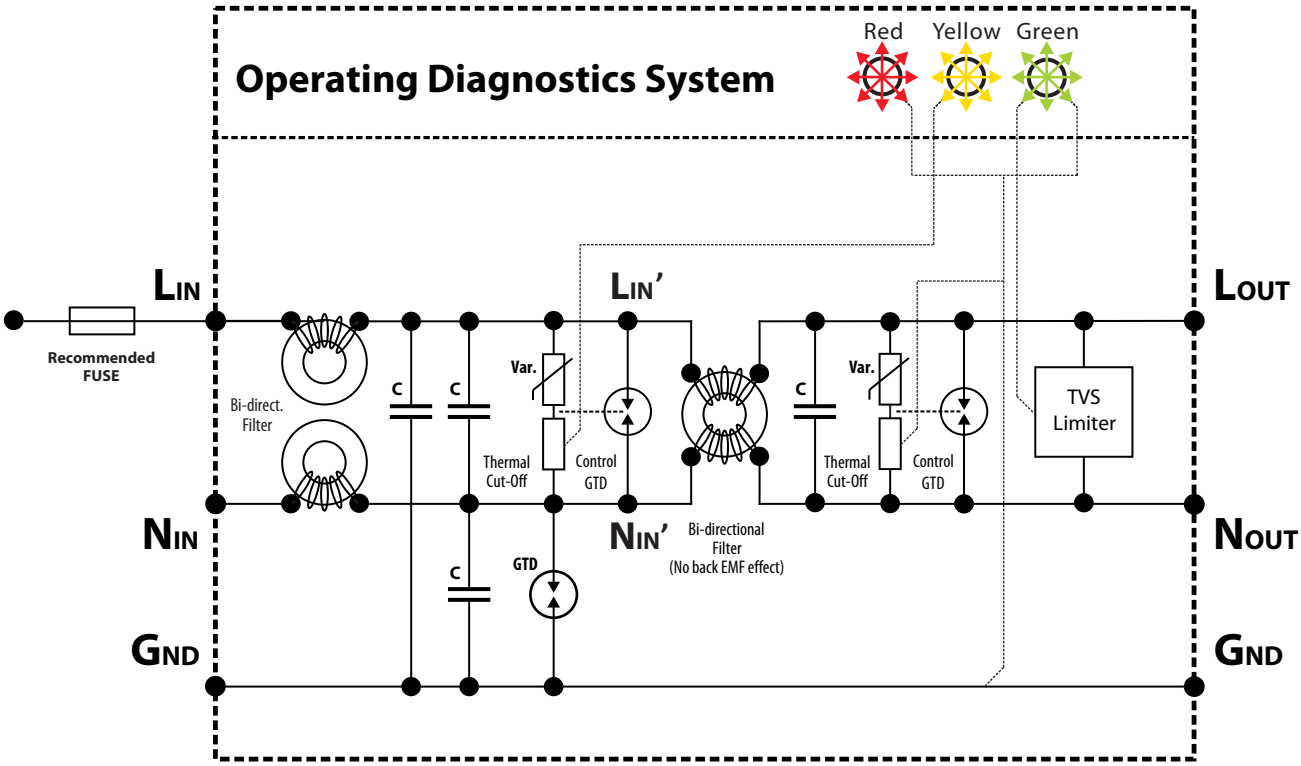
*Total Cost - Page no. 8;

3. Technical Specifications

ACDC Surge Protector Type - PS (11; 137; 146)-M Orange Series is compact stand alone multi-stage surge protector consists of 8 (eight) & 25A protection stages that provides effective and reliable protection against surges and transients. The protection device have high grade cascade bi-directional EMI/RFI filtering of phase (L) and neutral (N) wire and special diagnostic for condition of ground.

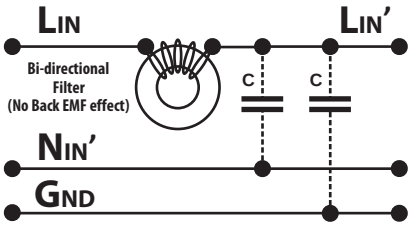
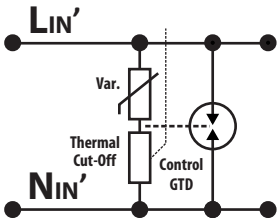
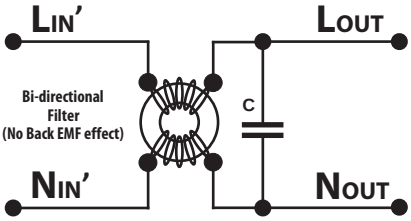
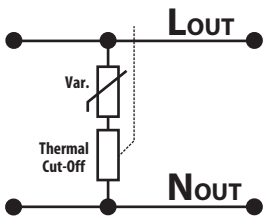
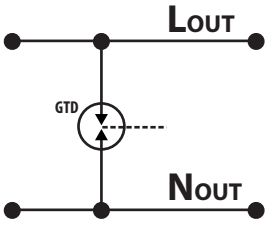
The protection unit consists of 8 (eight) protection stages for maximum load up to 25A per phase.

3.1 Basic Circuit Diagram - Orange Series



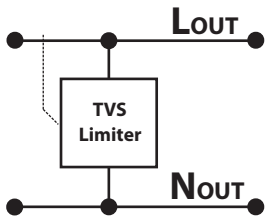
3.2 Eight (8) Stages Protector - Orange Series

EIGHT (8) PROTECTION STAGES - Orange Series

Stage 1 	**Function:** Bi-directional EMI/RFI filtering (L-N) Front signal edge reduction **Technical Specification:** L = 0,7mH; Imax = up to 25A; **Technology:** Nano Crystalline Core (L-C configuration) Special bi-directional winding
Stage 2 	**Function:** Suppression signal shape: 8/20us or 10/350us **Technical Specification:** Surge Cur. 80 to 125kA (8/20us) or Surge Cur. 12,5 to 20kA (10/350us) **Technology:** Varistor with thermal cut-off Control Gas Tube Discharge
Stage 3 	**Function:** Bi-directional Phase - Neutral EMI/RFI filter **Technical Specification:** L = 4,2mH; Imax = up to 25A; **Technology:** Nano Crystalline Core (L-C configuration) Bi-directional winding
Stage 4 	**Function:** Suppression signal shape: 8/20us **Technical Specification:** Surge Cur. 25kA (8/20us) **Technology:** Varistor with thermal cut-off
Stage 5 	**Function:** Long term signal suppression from 1µs to 2 sec. **Technical Specification:** This stage is the last Ultimate protection level. He switch-off the circuits breaker install upstream if the pick voltage > 300VDC for (120 VAC) or 520VDC for (230 VAC) appears on the output of the protection device. Circuits breaker should be < 200A gl/gG. **Technology:** Controlled Gas Tube Discharge

EIGHT (8) PROTECTION STAGES - Orange Series

Stage 6

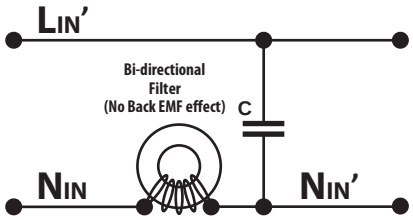


Function:
High speed efficiency signal suppression

Technical Specification:
TVS Limiter 500A (8/20us);
Typical response < 1ns (nanosecond)

Technology:
Transient Voltage Suppressor
(patented)

Stage 7

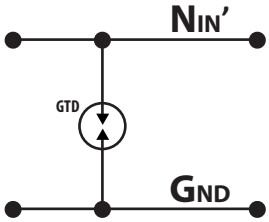


Function:
Bi-directional EMI/RFI filtering (N-L)
Front signal edge reduction

Technical Specification:
L = 0,7mH; Imax = up to 25A;

Technology:
Nano Crystalline Core (L-C configuration)
Special bi-directional winding

Stage 8



Function:
Long term signal suppression shape (N-Gnd)
8/20us or 10/350us

Technical Specification:
Surge Cur. 80 to 125kA (8/20us) or
Surge Cur. 12,5 to 20kA (10/350us)

Technology:
Varistor with thermal cut-off
Control Gas Tube Discharge

Operating Diagnostic Systems

Normal:
Continuous yellow and green

Led Indication for correct stage no. 2,4,6
The stages no. 1,3 and 7 (high garde bi-directional filtering) are always in function along with ultimate (5-th) protection stage.

Fault:
Continuous green

Led Indication for correct stage no. 4,6 and un correct no. 2. The stages no. 1,3 and 7 (bi-directional filtering) are always in function along with ultimate (5-th) protection stage.

Fault:
Blinking red

Led Indication for fault installation or poor grounding (Low impedance equipotential ground is not provided)

Fault:
Continuous red

Only stages 1,3 and 7 stages are still in function along with ultimate (5-th) protection stage.

3.3 Technical Specification Type - PS (11; 137; 146)-M Orange Series

Technical Specification ACDC Surge Protectors - Orange Series

Type	Type - PS 11-M	Type - PS 137-M	Type - PS 146-M
Order Code	500.215	500.216	500.217
Total Surge Current	Surge Cur. 105kA (8/20µs) or 15kA (10/350µs)	Surge Cur. 125kA (8/20µs) or 18kA (10/350µs)	Surge Cur. 150kA (8/20µs) or 22kA (10/350µs)
Product Standard	IEC61643-1 Class I+II+III (B+C+D); IEC60939-2		
1. Stage	**First Protection Stage**		
Function	Bi-directional filtering EMI/RFI (L-N); Front signal edge reduction;		
Technical Specification	L=0.7mH; Imax=up to 25A		
Technology	Nano Crystalline Core (L-C configuration)		
2. Stage	**Second Protection Stage**		
Function	Suppression signal shape (L-N), 8/20µs or 10/350µs		
Technical Specification	Surge Cur. 80kA (8/20µs) or 12,5kA (10/350µs)	Surge Cur. 100kA (8/20µs) or 15kA (10/350µs)	Surge Cur. 125kA (8/20µs) or 20kA (10/350µs)
Technology	Varistor with thermal cut-off; Control Gas Tube Discharge		
3. Stage	**Third Protection Stage**		
Function	Bi-directional EMI/RFI filter		
Technical Specification	L=4.2mH; Imax=up to 25A		
Technology	Nano Crystalline Core (L-C configuration)		
4. Stage	**Fourth Protection Stage**		
Function	Suppression signal shape (L-N), 8/20µs		
Technical Specification	Surge Cur. 25kA (8/20µs)		
Technology	Varistor with thermal cut-off		
5. Stage	**Fifth Protection Stage**		
Function	Long term signal suppression from 1µs to 2 sec.		
Technical Specification	This stage is the last ultimate protection level. He switch-off the circuits breaker install upstream, if the pick voltage > 300DC for (120 VAC) or 550VDC for (230 VDC) appears on the output. Circuits breaker should be < 200A gl/gG.		
Technology	Controlled Gas Tube Discharge		
6. Stage	**Sixth Protection Stage**		
Function	High speed efficiency signal suppression		
Technical Specification	TVS Limiter 500A (8/20µs); Typical response < 1nsec (nanosecond)		
Technology	Transient Voltage Suppressor		
7. Stage	**Seventh Protection Stage**		
Function	Bi-directional filtering EMI/RFI (N-L); Front signal edge reduction;		
Technical Specification	L=0,7mH; Imax=up to 25A		
Technology	Nano Crystalline Core (L-C configuration)		
8. Stage	**Eight Protection Stage**		
Function	Suppression signal shape (L,N-Gnd), 8/20µs or 10/350µs		
Technical Specification	Surge Cur. 80kA (8/20µs) or 12,5kA (10/350µs)	Surge Cur. 100kA (8/20µs) or 15kA (10/350µs)	Surge Cur. 125kA (8/20µs) or 20kA (10/350µs)
Technology	Varistor with thermal cut-off; Control Gas Tube Discharge		

3.4 Models of Surge Protectors - Orange Series

Single phase Models - ACDC Surge Protectors Orange Series

Technology:	Multi-Stage Surge Protection; Eight (8) Stages Series Protector
Specification:	Cascade bi-directional EMI-RFI filtering of phase (L) and neutral (N) wire
Load:	Up to 25A single phase; up to 3kW load for 120VAC; up to 5kW load for 230VAC
Options:	Indication for bed grounding, remote alarm
Installation:	Plug-in installation, schuko plug, terminal block or according requirements
Product Standard:	IEC61643-1 Class I+II+III; IEC60939-2

Type	Order Code	Total Surge Cur.	Dimension (WxDxHmm)	Weight (kg)
Type - PS 11-M	500.215	105kA(8/20μs) or 15kA(10/350μs)	220x50x45	1,6
Type - PS 137-M	500.216	125kA (8/20μs) or 18kA (10/350μs)	220x50x45	1,6
Type - PS 146-M	500.217	150kA (8/20μs) or 22kA (10/350μs)	220x50x45	1,6

4. Operation Diagnostic System

ACDC Surge Protectors Type -PS (11; 137; 146)-M Orange Series have advanced operating diagnostics system with state indication of three protection stages (2,4 and 6). It also gave us information for appropriate installation and has special diagnostics for ground condition.

Operating diagnostic system consists of 3 ledís:

Green, Yellow and Red that indicates three operating conditions of the Surge Protector:

4.1 Normal, 4.2 Damaged and 4.3 Fault Operating.

4.1 Normal Operation:

When the installation is made according to manufacturer instruction, Green and Yellow led are permanently ON.
- Yellow Led is indication for correct stage no. 2
- Green Led is indication for correct stage no. 4 and 6

If the stages 2,4 and 6 are out of function, the stages 1,3 and 7 are still provide a high grade bi-directional filtering along with ultimate fifth (5) protection stage.

4.2 Damaged Unit:

- If the surge protection stage no. 2 is burned or damaged the Yellow led will stop with continuous light.
- If the surge protection stages 4 and 6 are burned or damaged the Green led will stop to lit (with continuous light) and Red led will start to lit with continuous light.

4.3 Fault Operating:

Blinking of Red light indicates that low impedance of equipotent ground toward neutral is not provided.

In this situation the device can not guarantee 100% of protection of the electronic equipment. This situation is happening during an un appropriate installation or in the case when conditions of grounding is not satisfactory.

If Red led is lit continuous and user decide to replace ACDC Surge Protector is recommended to do that with the same type.

5. Used Technology

Using the most recent accomplishments of the advanced Nano Crystalline core materials we have developed and designed new generation of Integrated Series SURGE Protection devices. These devices are with a high grade of EMI/RFI filtering for application up to 25A and 8 (eight) protection stages with total response time of 1nsec.

The surge protectors from - Orange series have cascade EMI-RFI filtering of phase and neutral wire that provides most reliable protection.

Beside standard operating diagnostic system for each protection stage the device have additional signalization for ground condition.

Incorporating Nano Crystalline technology into a surge reduction filters represent a fundamental breakthrough in the overall design of the standard bi-directional filters.

Our new integrated protection designs are equipped with significantly more features and provide a higher level of performance achieved through new protection configurations, new materials and new approach to surge protection philosophy.

Nano crystalline core inductors, which are much smaller than non-saturating ferrite and air-core inductors, enable reduction of the dimensions and significant improvement of the final performances.

These benefits are reduced size, weight and heat dissipation. This combination of functions results in enhanced efficiency against transient over-voltages (low clamping voltage) and RF interferences.

High current capability, up to 25A, makes these protectors ideal equally for low power sensitive electrical devices and for industrial application.

ACDC Surge Protectors present a Multi-Stage Surge Protection composed of 8 (eight) surge protection stages. It is from class I + II + III according to standard IEC61643-1. He also meets the standards for protection of devices from electromagnetic (radio) interference IEC60939-2.

The first part of innovation is use of four (4) complementary different protective technologies, (Varistor, Gas Tube, Nanocrystalline Cores and TVS technology) in one unit with result of reducing the surge current up to 99.9% at single point. This characteristic competitive surge products canít offer.

The second part of innovation is simple and easy application of ACDC Surge Protectors applying of international protection standards (IEC 62305-4 & ANSI/IEEE C62.41.1-2). This solution expel need of several surge protectors installed separately in each boundary protection zone (LPZ0a/LPZ0b-LPZ3 & C-A).

With simple words, design and planning of surge protection is not any more reserved just for experts in this field. It's become simple and applicable from professions such as planners, construction engineers, designers, electricians and others.

These two innovations regarding used technology (Multi-Stage design) and simplest application for surge protection of devices are remarkable advantage toward other surge products which can be find on worldwide markets.

Using of ACDC Surge Protectors are excellent choice for the INVESTMENT in quality of your power network supply.

Our products, manufactured in accordance with the highest quality standards, can offer safety covered by the latest state of the technology.

6. Reduce Total Cost

The need of surge protections is growing rapidly. Newest generation of sophisticated electronic devices are more sensitive to electrostatic discharges and over-voltage spikes in power distribution networks and requiring new approach to the surge protection with improved quality and reliability. The integrated multi-stage surge protection system significantly reduces the total cost trough:

7.1 Applying standard IEC 62305 & ANSI/IEEE C62.41.1-2 (Lightning international protection standard) requires several independent surge protectors installed separately in each boundary protection zone LPZ0a/LPZ0b-LPZ3 & C-A. ACDC Surge Protector presents multi-stage protection system with 8 (eight) protection stages in one device, expelling the need of use of surge protectors in other protection zones, while reducing surge current up to 99.9% (at single point).

7.2 Expel installation and cost of several independent surge protectors in different boundary zones according standards ANSI/IEEE C62.41.1-2 & IEC 62305;

7.3 Expel the need of surge expert engineer regarding installation of several protectors on different places;

7.4 Expel need for coordinated protection.

7.5 Reduce the cost of protector installation.

7.6 Reduce space requirements.

7.7 Lower maintenance expenditures.

7.8 Extremely high protection efficiency and reliability.

7.9 Reduced cost of maintenance of the protected equipment regarding higher MTBF.

7.10 ACDC Surge Protectors are excellent choice for investment in quality of your power network supply. If the stages 2,4 and 6 are out of function, the stages 1,3 and 7 are still provide a high grade cascade bi-directional filtering among with ultimate (5-th) protections stage.

7.11 Recommended usages of integrated multi-stage surge protection system ACDC Surge Protectors on sites were standard IEC 62305 & ANSI/IEEE C62.41.1-2 was not implemented on boundary zones LPZ0a/LPZ0b-LPZ3 & C-A or in case of absence of any surge protectors.

7. Advantages

With built in 8 (eight) protection stages, ACDC DCAC customers are able to implement the most effective and reliable protection solution against surges and transients.

ACDC Surge Protector - Orange Series as multi-stage protection have following advantages:

8.1 AC DC Surge Protector is advanced Integrated Multi-Stage Surge Protector, consists of eight (8) protection stages that provide effective and reliable protection against surges and transients coupled with state-of-the-art EMI/RFI filtering;

8.2 ACDC Surge Protector provides a systematic approach on two fronts: Surge protection and Hi-bidirectional filtering. While there are companies and products that attempt one of these, ACDC Surge Protectors is the only product that

The ACDC Surge Protectors - Orange Series have cascade EMI-RFI filtering of phase and neutral wire that provide reliable protection toward all kind of surges and transients.

seamlessly merges the two different protection technologies. The unique multistage design provides the most advanced power filter protector;

8.3 The ACDC Surge Protector is Multi-Stage Surge Protector of class I+II+III in one device according to IEC61643-1 that reduced surge events in excess of 99% at a single point. They also full fill standard requirements for electromagnetic (radio) interference IEC60939-2;

8.4 With installation of ACDC Surge Protectors applying of international protection standards (IEC 62305 & ANSI/IEEE C62.41. 1-2) become simple and easy. These protectors are expelling the need for several separate installation of surge protectors at each protection boundary zones C-A & LPZ0a/LPZ0b-LPZ3;

8.5 The complex analyses and multitude of criteria defined in lightning protection standard become the past. With ACDC Surge Protectors planning and installation of surge protection is not just reserved for an expert surge engineers but it is available to wide branch of professions. (electrician, construction builders, IT..);

8.6 The appearance of ACDC Surge Protectors on the market significantly REDUCED TOTAL INVESTMENT COST and presents new inovation regarding simplicity of applying of international lightning protection standards.(IEC 62305 & ANSI/IEEE C62.41. 1-2);

8.7 Reducing TOTAL cost regarding number of necessary install surge protector at each protection boundary zones C-A & LPZ0a/LPZ0b-LPZ3;

8.8 Reducing TOTAL cost regarding efficiency, reliability, installation, space requirements and maintenance;

8.9 Special design enables effective protection on locations where the grounding is poor or does not exist;

8.10 The ACDC Surge Protectors provide a clean, multi-stage filtered power supply with a high grade of attenuation and current capability of up to 25A to all connected units;

8.11 The design of the protectors is specially adapted for new demands in protection of switch mode power supplies in computers, servers, telecommunication, medical and military equipment providing a higher level of performance;

8.12 Those performances are achieved using New materials, New design and New approach of surge protection philosophy (Nano Crystalline core materials and semiconductors);

8.13 Special design of ACDC Surge Protectors can solve the problem of network and ground contamination during direct lightning strikes, successfully protecting electrical and electronic systems within structures (buildings). This is most advanced effective concept for protection for computer equipment, telecommunication equipment, home appliances.

8. Reliability

Usage of ACDC Surge Protectors Type-PS (11; 137; 146)-M Orange Series is excellent choice for the investment in quality of your power network supply, extended equipment life and reduce their down time and errors.

9.1 If protector have damaged or burned stages 2,4 or 6 the stages 1,3 and 7 are still in function among with ultimate (5-th) protections stage.

9.2 If users decide to replace ACDC Surge Protectors is recommended to do that with same type.