4A-PLASMA

J.Schneider Elektrotechnik

Pulsed ARC

Pulsed ARC

- Motivation - Why pulsed ARC?
- History of ..

- **PLASMA*TEC* ARC**
- Product Info
- Advantages of J.Schneider pulsed ARC

- **PLASMA*TEC* pulsed BIAS**
- Product Info

- Conclusion

Pulsed ARC

Why pulsed ARC ?

- less droplets -> smoother surface *
- better control of film properties *
- higher deposition rate, shorter cycle time *
- higher target utilization *
- lower race-track formation *
- higher plasma density *

* All of the above statements is the information from a highly relevant expert at the time (name withheld) and the reason this pulsed ARC technology (in this power, current, frequency range, the rise time, overshoot, etc….) was developed in the first place. Unfortunately, no further information or evident data or publications from this person is available.

Why pulsed ARC at J.Schneider? -> Customer Request

Pulsed ARC

History

- Request for large substrates for 200A - 400A plus upscale ability to 800 / 1600 A
- 2005 - 2006 this technology (in this power/current, variable frequency, etc…) was introduced
- 2012 – 2013 this technology has been newly developed and significantly upgraded by J.Schneider (via a customer request)
- approx. 40 systems in the field
- Development and Introduction of a compatible pulsed Bias PS 2018

Pulsed ARC

PLASMA*TEC* ARC-Supplies for cathodic pulsed ARC-evaporation

Optimized for “low droplet (close to droplet free)” pulsed ARC processing

- Small footprint, water cooled
- up 16kW, up to 400A (100A/200A)
- Inherent Current Source technology, that insures stable ARC-Current (CFC)
- Low stored energy (designed for fast pulsing)
- Advanced pulsing capability (Multilevel Pulsing)
- Accurate Current Control with low (or better-> No) current overshoot

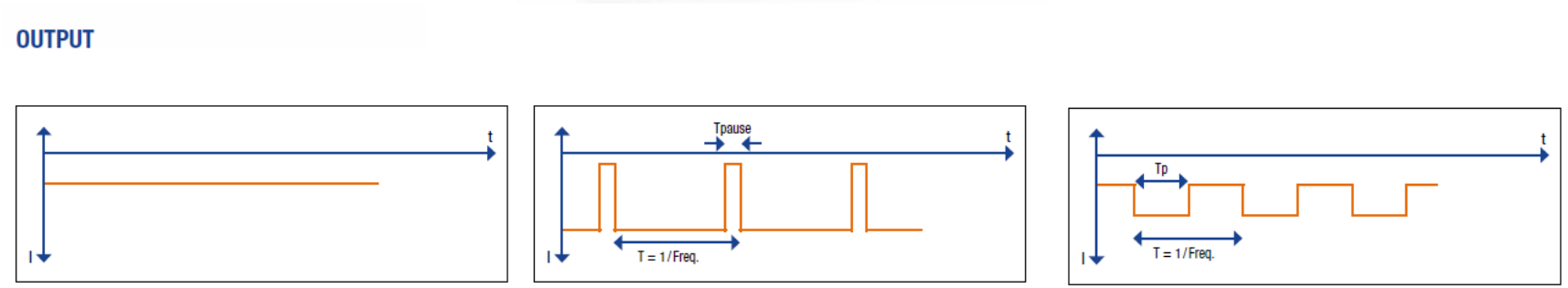
Pulsed ARC

Products

PRODUCT NAME ARTICLE NUMBER	PLASMA*TEC ARC* 030200 [6kW] NACR1436F01001	PLASMA*TEC ARC* 030400 [12 kW] NACR1437F01001	PLASMA*TEC ARC* 080200 [16 kW] NACR1439F01001
MAINS			
Input voltage	3 x 400 V AC +/- 10 %		
Nominal frequency	50 / 60 Hz +/- 5 %		
Max. input current	25 A	25 A	30 A
OUTPUT DC MODE			
Nominal output voltage [Vav]	30 V DC (60 V open voltage)	30 V DC (60 V open voltage)	80 V DC (140 V open voltage)
Nominal output power [kW]	6 kW @ 30 V	12 kW @ 30 V	16 kW @ 80 V
Nominal output current [Aav]	200 A	400 A	200 A
OUTPUT PULSED MODE			
Nominal output voltage [Vav]	30 V (60 V open voltage)	30 V (60 V open voltage)	80 V (140 V open voltage)
Nominal output power [kW]	6 kW	12 kW	16 kW
Nominal output base current [Aav]	0 – 200 A	0 – 400 A	0 – 200 A
Nominal output peak current [Aav]	Base current – 200 A	Base current – 400 A	Base current – 200 A
Max. ignition voltage [Vig]	60 V (depending on mains input voltage)		140 V
Pulsing frequency	DC, 1 Hz to 250 Hz		
Duty cycle ≙ Tp	1 % to 99 %		
Minimum pulse length	500 µsec		
Interfaces (optional interfaces see page 18)	I/O interface / RS232 interface		
Dimensions (h x w x d)	133.35 x 482.6 x 600 (725 plug included) mm 3HU x 19" x 600 mm		

Pulsed ARC

Products



Pulsed-ARC

Duty-Cycle 50%,

Imax = 200 A

Imin = 80 A

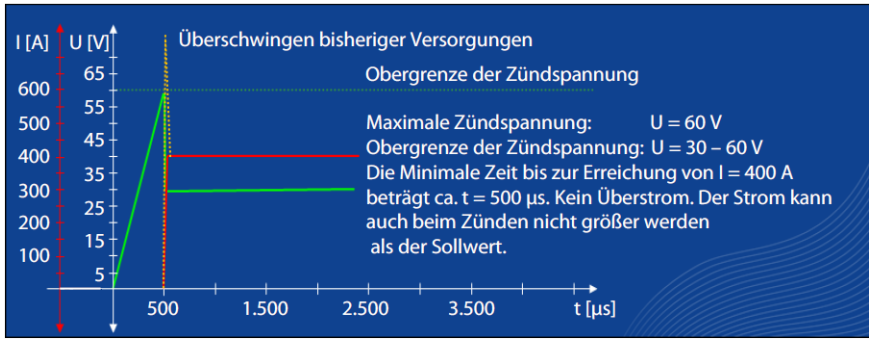
Duty-Cycle 25%

Imax = 400 A

Imin = 80 A

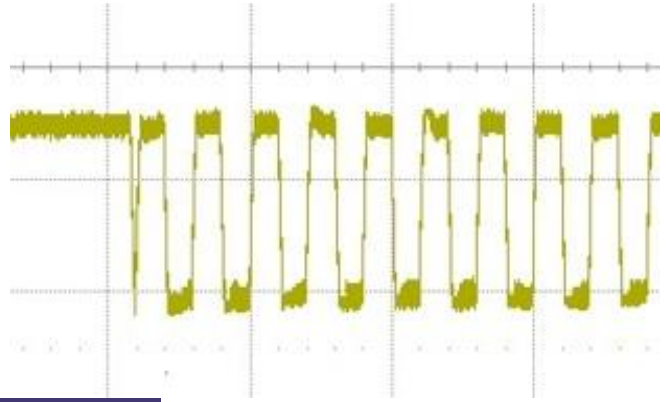
Pulsed ARC

Products Advantages



Controlled Ignition Behaviour

Pulsed Ignition



Fast Rate of Rise

„Square Wave Form“

Pulsed BIAS

Pulsed Bias

TECHNICAL DATA

PRODUCT NAME ARTICLE NUMBER	PLASMA*TEC BIAS* 1k07k5 [7.5 kW] NDCR1726F01002	PLASMA*TEC BIAS* 1k015k [15 kW] NDCR1727F01002
MAINS		
Input voltage	3 x 400 V AC +/- 10 %	
Nominal frequency	50 / 60 Hz +/- 5 %	
Max. input current	34 A	34 A
OUTPUT		
Nominal output voltage [Vav]	300 – 1000 V DC	300 – 1000 V DC
Nominal output power [kW]	7.5 kW	15 kW
Nominal output current [Aav]	25 – 7.5 A	50 – 15 A
Frequency of output voltage	DC 1 kHz to 30 kHz unipolar pulsed 1 kHz to 15 kHz unipolar pulsed	
Duty cycle in pulsed mode	see table below	
Connection in parallel	Up to 2 units	
Interfaces (optional interfaces see page 18)	I/O interface / RS232 interface	
Dimensions (h x w x d)	133.35 x 482.6 x 600 (725 plug included) mm 3HU x 19" x 600 mm	

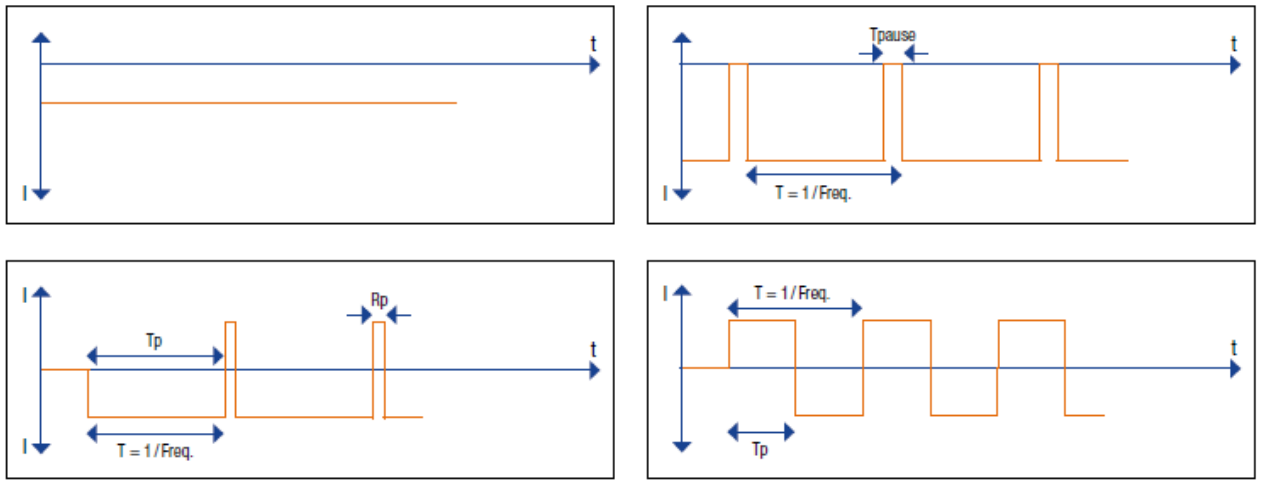
Pulsed BIAS

Pulsed Bias

BACK VIEW

DC POSITIVE OR DC NEGATIVE			
1 – 6 kHz	3 – 99 %	21 – 26 kHz	3 – 96 %
7 – 13 kHz	3 – 98 %	27 – 30 kHz	3 – 95 %
14 – 20 kHz	3 – 97 %	DC not pulsed	100 %
BIPOLAR			
Frequency	Tp Pos. pulse	Rp Neg. pulse	Pos. + neg pulse max.
1 – 2 kHz	3 – 98 %	1 – 96 %	99 %
3 – 4 kHz	3 – 97 %	1 – 95 %	98 %
5 – 6 kHz	3 – 96 %	1 – 94 %	97 %
7 – 8 kHz	3 – 95 %	1 – 93 %	96 %
9 – 10 kHz	3 – 94 %	1 – 92 %	95 %
11 – 12 kHz	3 – 93 %	1 – 91 %	94 %
13 – 14 kHz	3 – 92 %	1 – 90 %	93 %
15 kHz	3 – 91 %	1 – 89 %	92 %

OUTPUT



Pulsed ARC

Conclusion -> Why pulsed ARC ?

- less droplets -> smoother surface
- better control of film properties
- higher deposition rate, shorter cycle time
- higher target utilization,
- lower race-track formation
- higher plasma density
- advantages for targets with low electrical conductivity

Many of the above statements obviously have been made evident by: TRISTAN AiF Project No# 2043

This is not the end; more advantages should show when pulsed ARC and pulsed BIAS is combined.

-> Opportunities for further testing welcome (with/without pulsed BIAS) !

Thank you for your attention !!

4A-PLASMA

Gerhard Eichenhofer
Aichtalstr. 66
D-71088 Holzgerlingen

Phone: +49-(0)7031-8175680
email: info@4a-plasma.eu
www.4a-plasma.eu