



SPIK3000A HiPIMS DC Power Controller



SPIK3000A: HiPIMS 5kW – 30kW

Synchronization of Superimposed Pulse Power Technology
with MELEC GmbH SYNC MY2020 SOFTWARE

**Synchronization
of HiPIMS, Mid-Freq. and rf 13.65 MHz
up to 8 Channels**



see page 4,5



ICMCTF 2022
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PSE 2022 – International Conference on Plasma Surface Engineering
September 12 - September 15



MELEC GmbH – The High Pulse Power Company

MELEC GmbH's scope of delivery: SPIK3000A DC Pulse Power Controller for complete HIPIMS sets for single and dual magnetrons. DC average power ranges from 3kW–30 kW.

For industrial applications 90kW max. Pulse train freely adjustable. Our new trigger system allows synchronization for Super-Imposed Pulse Power (SIPP) applications HIPIMS and Mid-Freq. for single and dual magnetrons and biasing. Expansion up to 8 trigger channels.

Advantages: highest deposition rate, reduce/prevent arcing/poisoning, highest process stability tuning reproduceable, low cost retrofit applications.

Improvements are: higher ion bombardment, better coating adhesion, harder coating, denser films. Thin film structure is easily controllable in SIPP Technology.



MELEC GmbH, Germany



SHENCHANG, Taiwan (licensed production)





SPIK3000A HiPIMS DC Power Controller



SPIK3000A: HiPIMS 5kW – 30kW

Applications:

- HiPIMS
- HiPIMS + MF
- HiPIMS + Bias
- Bias (unsynchronized)
- Pulsed DC
- Plasma CVD
- Plasma Diffusion
- Plasma Nitriding
- Plasma Etching
- Plasma Cleaning
- Plasma Electrolytic Oxidation PEO

Features:

- DC – 25/50kHz pulse frequency range
- Fast arc detection and suppression less than 2 μ s
- Pulse on-time 5 μ s – 16ms
- Pulse off-time 5 μ s – 32ms
- Output modes: DC-, UP+, UP- and BP
- Symmetric voltage output
- FPPG (Free Pulse Pattern Controller up to 8 pulses)
- 2 x Trigger output / 1x Trigger input
- Water cooled
- 19" 7U Rack Mount
- Remote interface (Profibus / RS485)

Type	DC Power (kW)	DC Voltage (V)	DC Current (A)	Pulsed Peak Power (kW)	Frequency range
A-05-EF	5 kW	1000 V	10 A	500 kW	DC – 50kHz
A-10	10 kW	1000 V	25 A	1000 kW	DC – 25kHz
A-20	20 kW	1000 V	35 A	1000 kW	DC – 25kHz
A-30	30 kW	1000 V	50 A	1000 kW	DC – 25kHz

ADL GmbH DC Power Supply GS – Type: 0.5kW – 3kW



Features:

- Output power 0.5 -3.0 kW
- Air cooled
- 1/2 19"-case, 3 HU
- Interchangeable Interfaces
- Display for voltage, current and power
- Manual operation via frontpanel
- Automatic Arc Handling

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ADL GmbH DC Power Supply GX – Type: 5kW – 15kW



Features:

- Output power 5 – 15kW
- Water cooling
- 1/2 19"-case, 3 HU
- floating output
- Display of actual value for U, I or P
- Automatic Arc Handling

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ADL GmbH DC Power Supply HX – Type: 15kW – 35kW



Features:

- Output power 15 kW – 35 kW
- Parallel operation up to 280 kW
- Water cooling
- Magnetic valve control
- Housing ventilation with integrated particle separator
- 1/2 19"- case, 5 HU
- Flange mounting
- M8-female thread for crane eye
- Replaceable, rotatable display
- Automatic Arc Handling

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MELEC GmbH SPIK3000A-CC Software



Synchronization of Superimposed Pulse Power Technology with MELEC GmbH SYNC MY2020 SOFTWARE

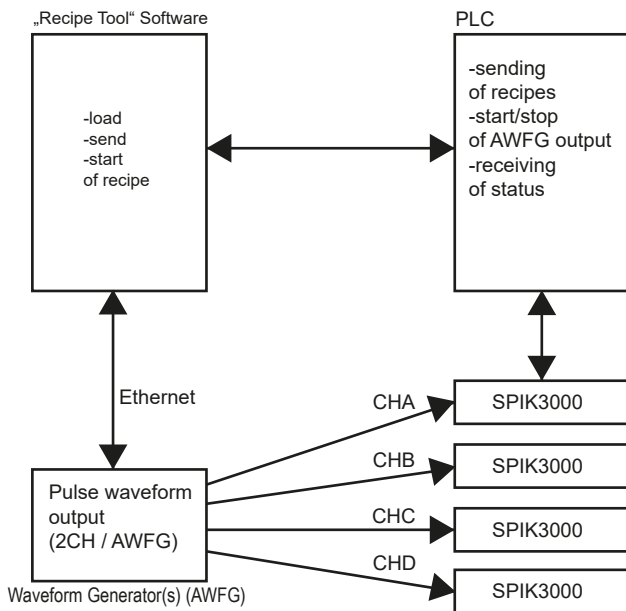


Fig. 1

The SYNC system is designed to synchronize up to eight pulse devices using arbitrary function generators (AWFG). The AWFGs are controlled using the recipe tool software, which forms the link between the PLC and the AWFG. The pulse pattern is created using the Pulse Editor software.

Table 1: SYNC models

Type	Channels
Sync-2	2 CH
Sync-4	4 CH
Sync-6	6 CH
Sync-8	8 CH

Synchronization of BIAS

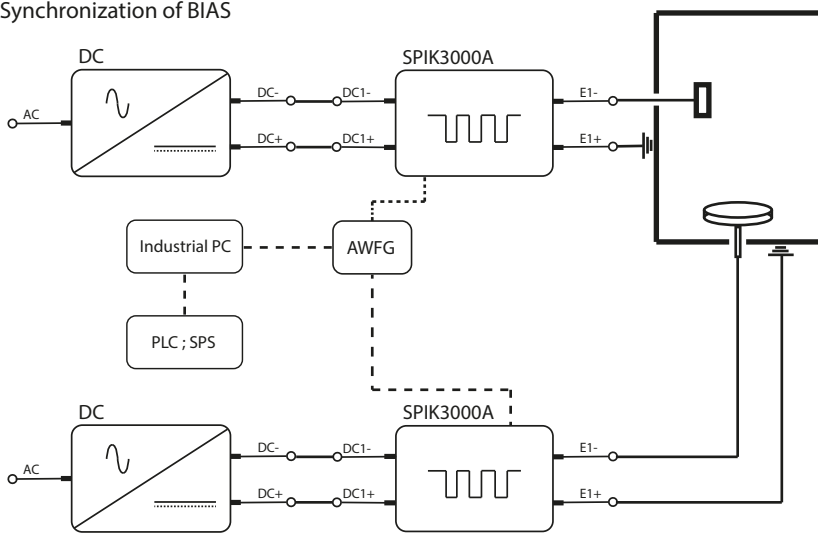


Fig. 2

FIG. 2 shows a HiPIMS set on a single magnetron with a pulsed BIAS supply which can be freely triggered by means of the synchronization unit using the MELEC GmbH SYNC MY2020 software.

With non-conductive substrates, a triggerable rf power supply (13.65 MHz) can be used for the BIAS instead of the SPIK3000A-EF-05.

At the beginning of the HiPIMS pulse, gas IONS are predominantly present and afterwards the sputtered metal ions are formed.

When switching on the BIAS trigger signal with delay after the HiPIMS trigger signal, a decrease in gas content can be proven in the PVD layer.



Fully synchronized Bias Basic Form Fig. 3



Synchronized Bias + Delay Fig. 4



Example of PVD Coating System

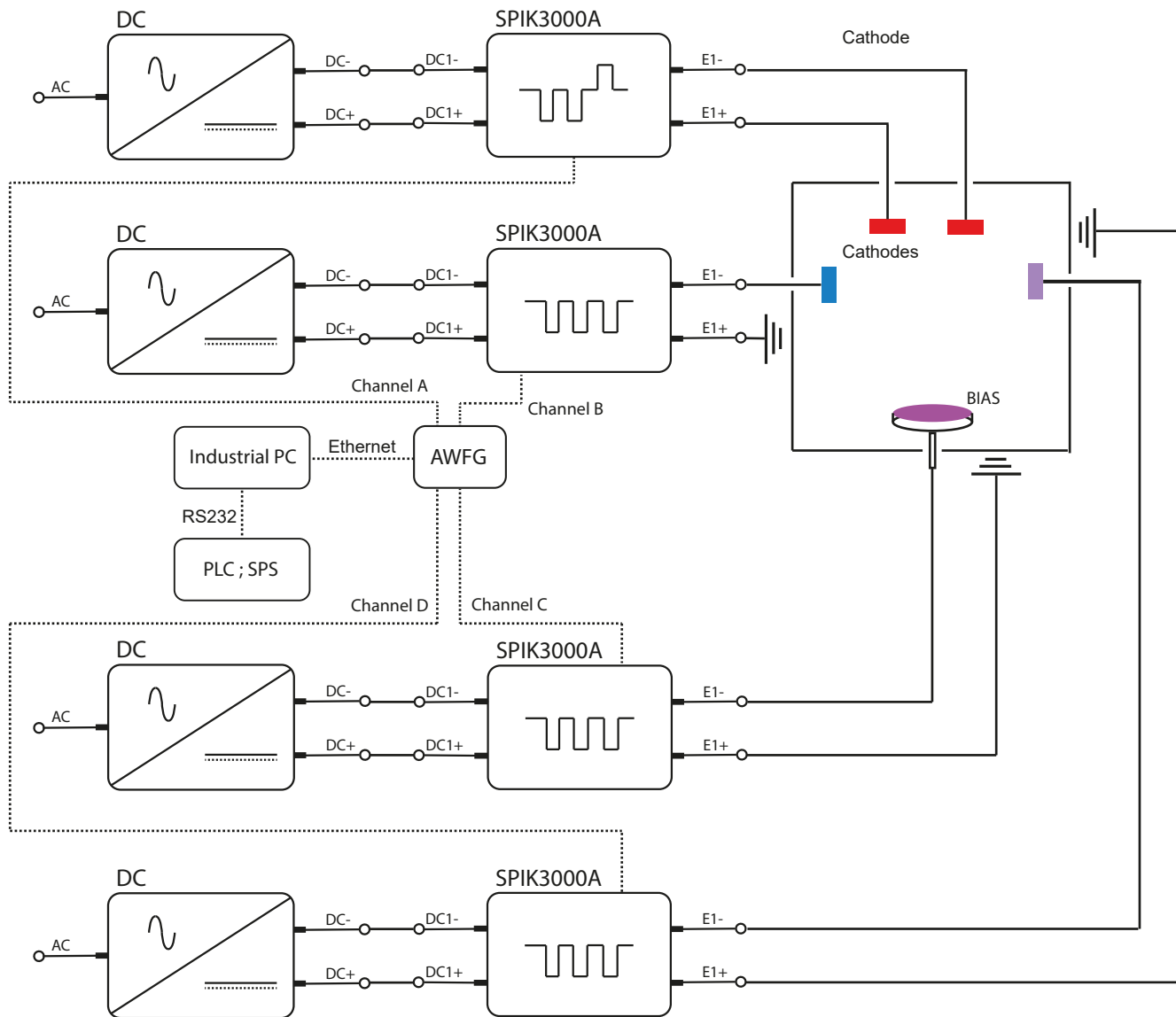


Fig. 5

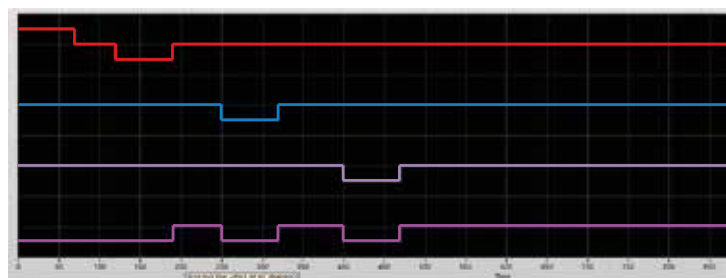


Fig. 6

The drawing shows a PVD device with 2 single magnetrons and 1 dual magnetron system and a pulsed BIAS power supply. All magnetrons are operated using a trigger system in HiPIMS mode.

A phase shift of HiPIMS pulses may be necessary not to overload the BIAS power supply.

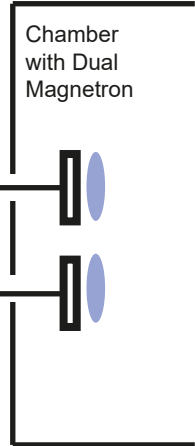
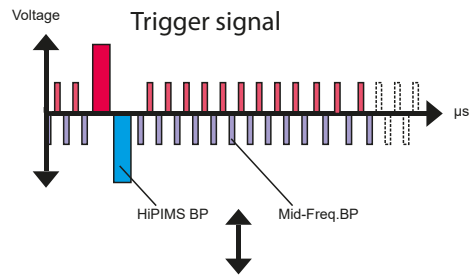
Other applications could be for example co-sputtering or combinations with HiPIMS and Mid-frequency.



Superimposed Pulse Power Technology HiPIMS + Mid-Freq. (25/50 kHz)



SPIK3000A
DC Pulse Power Controller



ADL GmbH
DC Power Supply



Channel A
Trigger signal

ethernet
cable



Industrial PC

Process logic computer,
Programmable logic controller

Fig. 7

In FIG. 7 shows new application of a dual magnetron system with a HiPIMS set SPIK3000A and a DC power supply using a trigger system in super position HiPIMS and Mid-frequency.

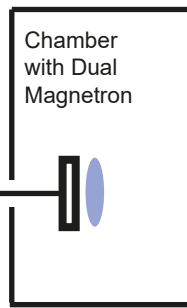
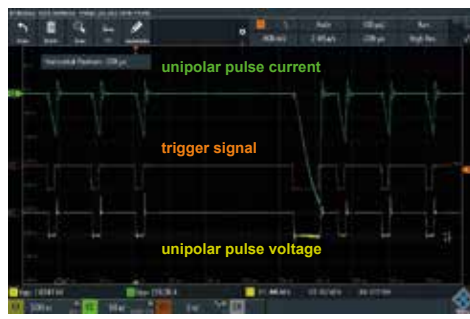
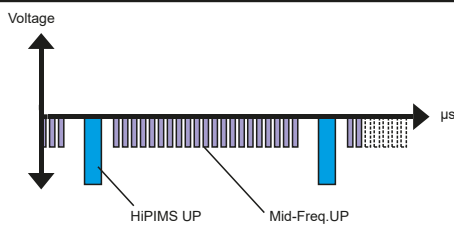


Fig. 8

Advantages of SIPP-HiPIMS Technology

unipolar and bipolar pulsing:

- highest deposition rate
- reduce/prevent arcing/poisoning
- highest process stability
- tuning reproduceable
- low cost retrofit applications

Improvements of SIPP-HiPIMS Technology

unipolar and bipolar pulsing:

- higher ion bombardment
- better coating adhesion
- harder coating
- denser films
- Thin film structure is easily controllable in SIPP Technology



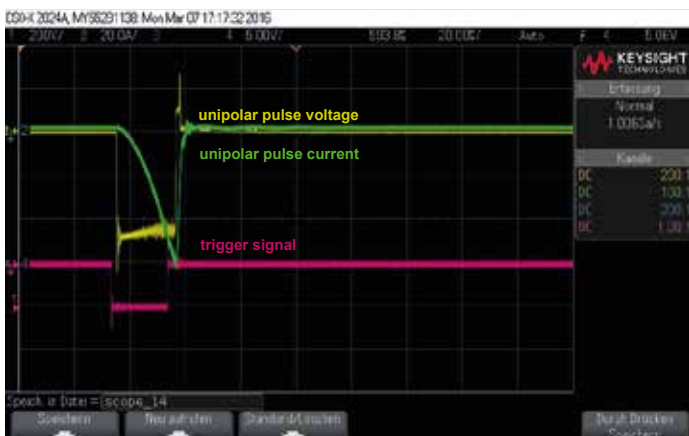
MELEC GmbH Measurement System



Features:

- U Ratio: 0V-1000V = 0V-5V attenuation: x200
- Voltage BW: DC-300kHz
- I Ratio: 0A-500 A / 1000A = 0V-5V attenuation: x100 (500A) / x200 (1000A)
- Current BW: DC-200kHz
- 1 U/125mm depth
- TB (Terminal Box) include voltage and current transducer (option)

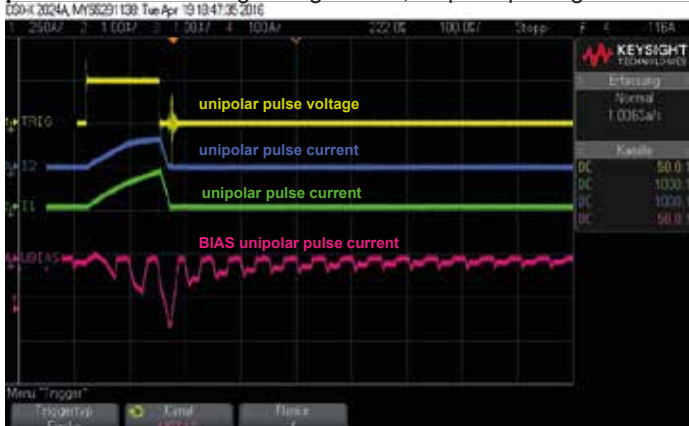
picture P1.1: Single magnetron, unipolar pulsing



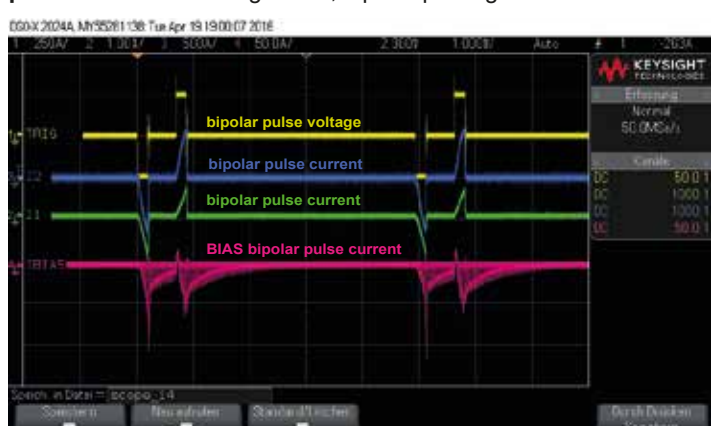
picture P1.2: Single magnetron, unipolar pulsing with pre ionisation



picture P1.3: Two single magnetrons, unipolar pulsing



picture P1.4: Dual magnetron, bipolar pulsing



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