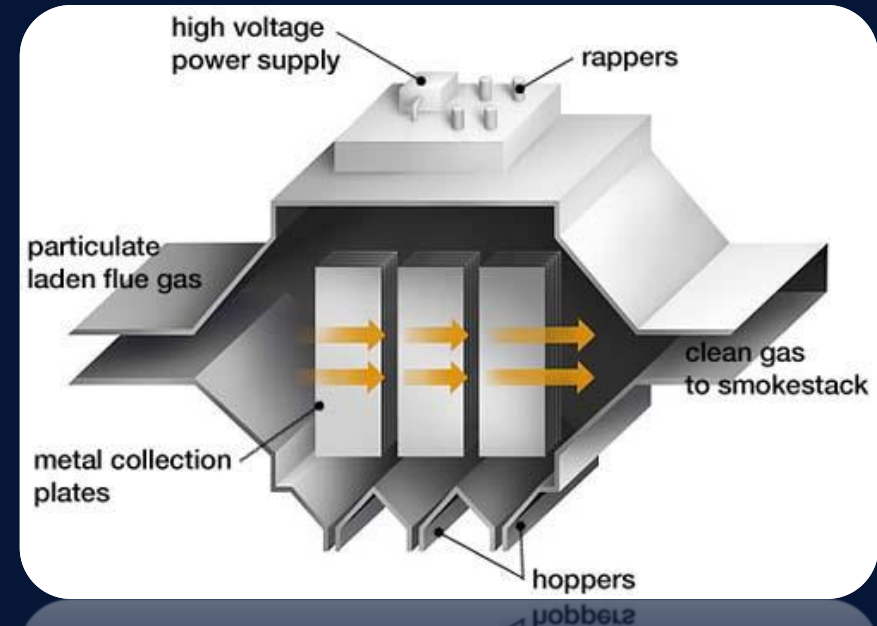




High Voltage Products / Solutions
Electrostatic Precipitators

2019

Power Supply for ESP application



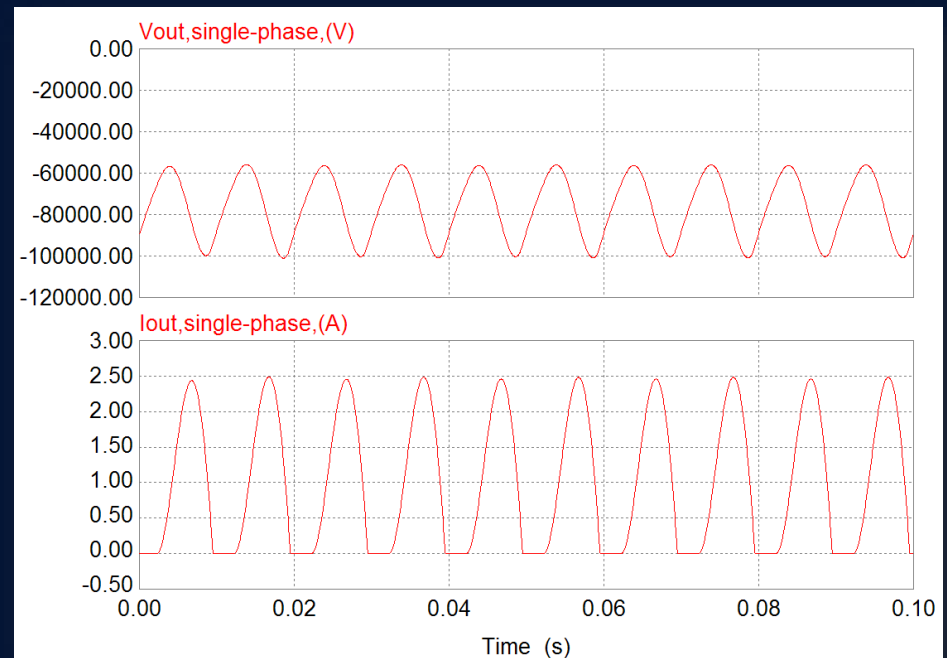
Kraft Classic single-phase CC + TR unit



- From 50 kV to 150 kV and from 100 mA to 4500 mA
- Two units CC + TR

Output characteristics

- High voltage ripple $\approx 40 - 50 \%$
- Average voltage $\approx 75 - 80 \%$ of peak voltage
- Ripple frequency = 120 Hz

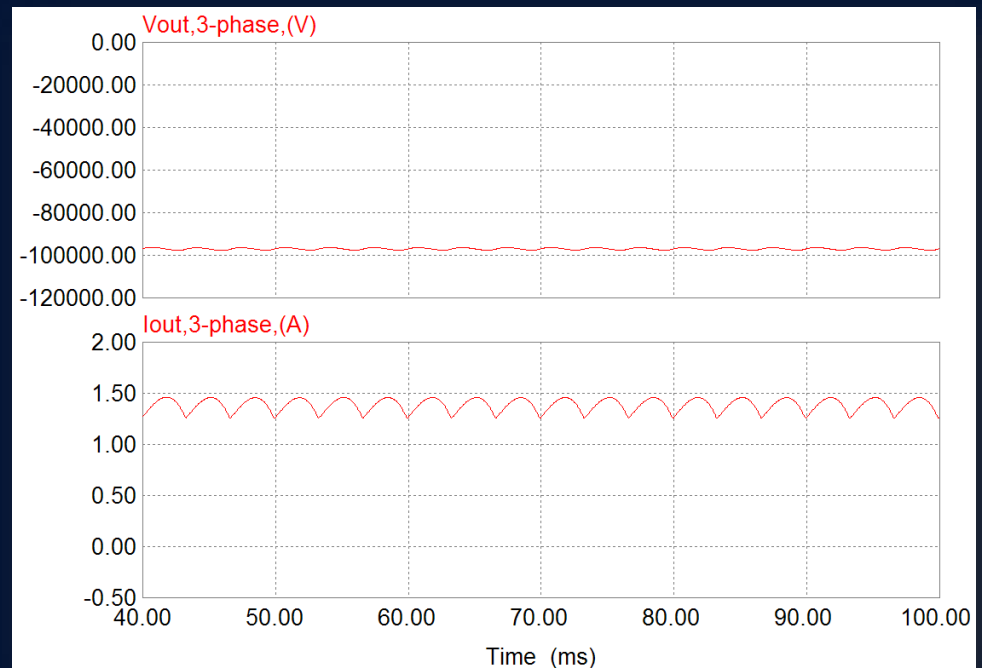


Kraft Classic 3-phase CC + TR unit



Output characteristics

- Low voltage ripple $\approx 1 - 2 \%$
- Average voltage $\approx 98 - 99 \%$ of peak voltage
- Ripple frequency = 360 Hz



- Up to 150 kV and 4500 mA
- Two units CC + TR
- Lower output ripple compared to single-phase TR

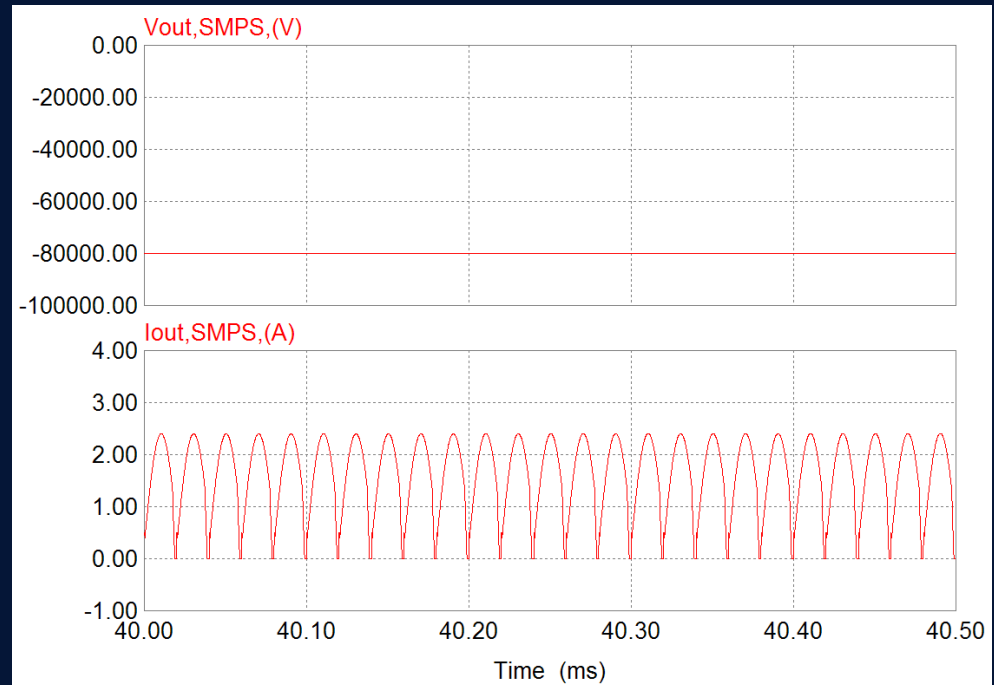
High Frequency SMPS unit "SmartKraft +"



- Primary switched HF technology
- Up to 90 kV-1600 mA (72kV -1800 mA)
- One unit – No separate Control Cubical
- Low weight = 25% to 50% of T/R

Output characteristics

- Very low voltage ripple < 1 %
- Average voltage \approx peak voltage
- Ripple frequency = 24 kHz
- Highest Power Factor



MicroPulse 2

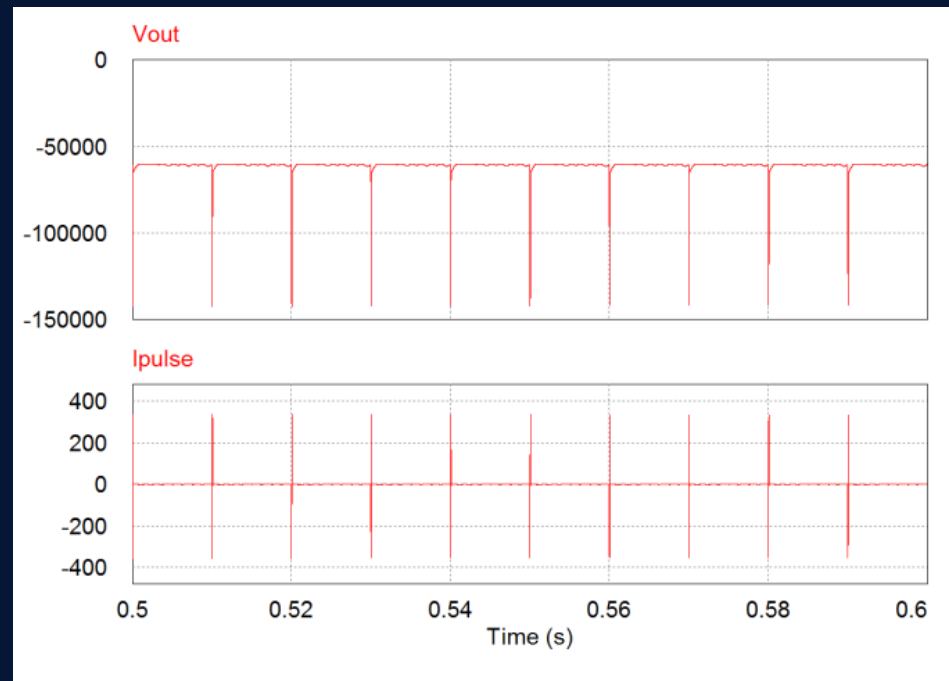
Is design by integration of 2 separate power supplies: DC + Pulse



- Output DC Voltage : 60kV
- Output DC Current : 1000mA
- Output Peak Voltage: 140kV

Output characteristics

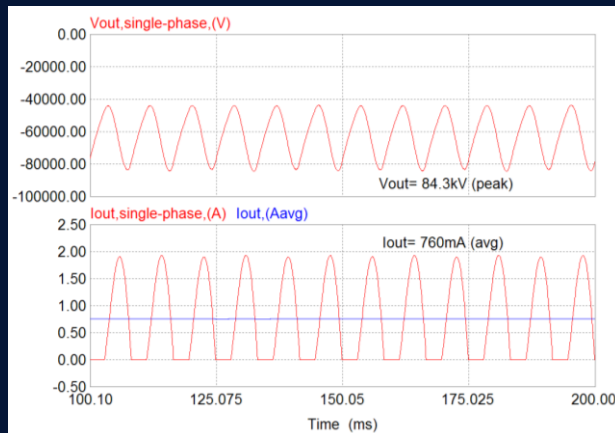
- Very high voltage peaks and high pulse current
- DC voltage with low ripple
- Pulse repetition frequency = 2-100Hz
- Increase voltage peaks by the shore pulse length



Summary waveform comparison

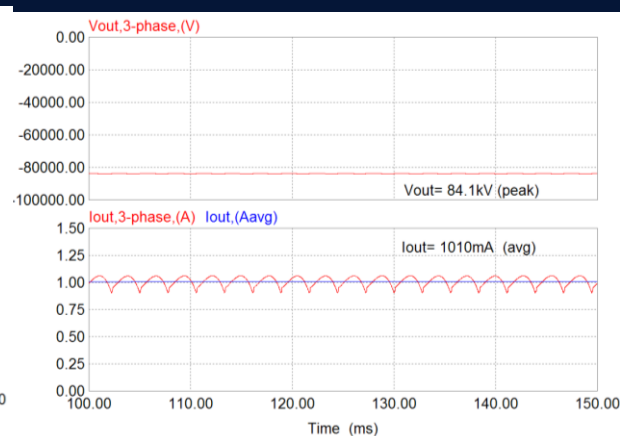
Single-phase TR unit

- 120 Hz current ripple
- Results in $\approx 35\text{-}45\%$ ripple voltage on an ESP load
- Voltage peaks limits the current into the ESP



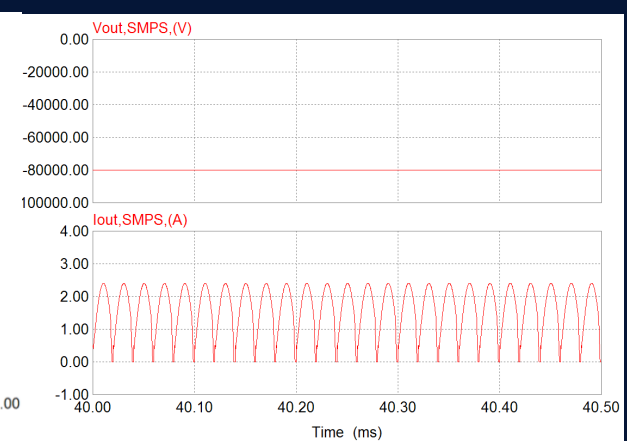
3-phase TR unit

- 360 Hz current ripple
- Results in $\approx 0.5\text{-}1.5\%$ ripple voltage on an ESP load
- 30–40% higher current into the ESP compared to single-phase TR



High frequency SMPS

- 24kHz current ripple
- Results in $< 1\%$ ripple voltage on an ESP load
- 30–40 % higher current into the ESP compared to single-phase TR



Design Comparison



SmartKraft DC

- Oil Cooled
- 12 IGBT's
- Aluminium Tank
- Phase Shift Series Resonant Converter – Amplitude Control

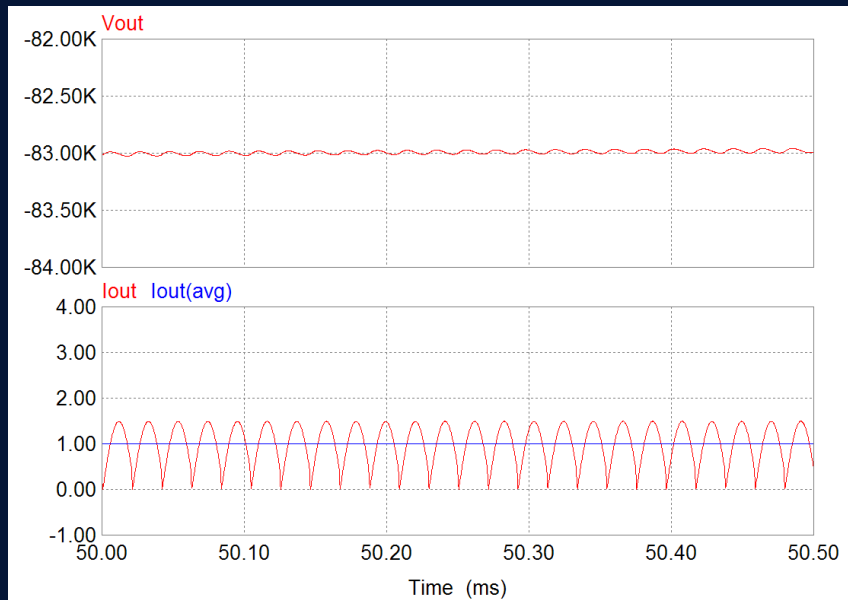
Competitor

- Air Cooled
- 4-6 IGBTs
- Steel Tank
- Frequency Controlled Series Resonant Converter

SMPS waveforms for different topologies

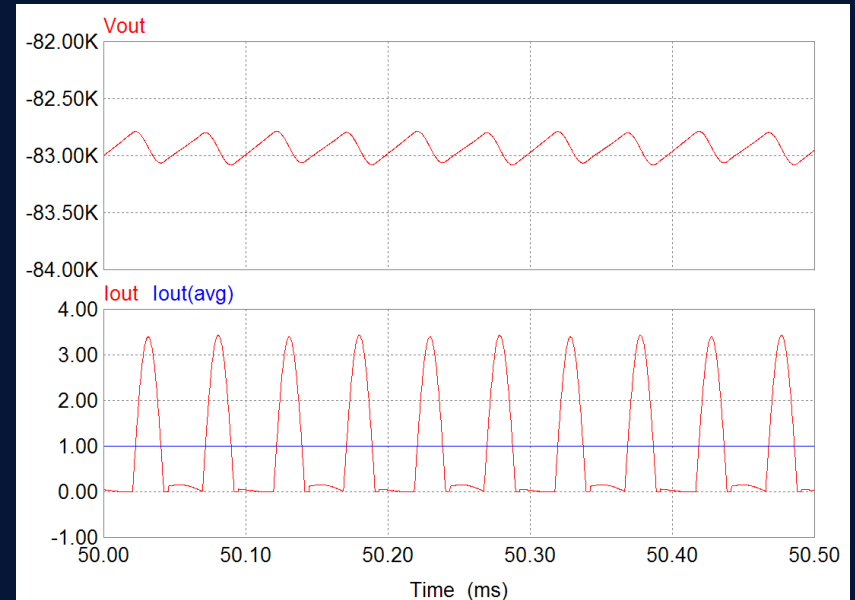
SmartKraft DC

Phase Shift Series Resonant Converter



Competitor

Frequency Controlled Series Resonant Converter

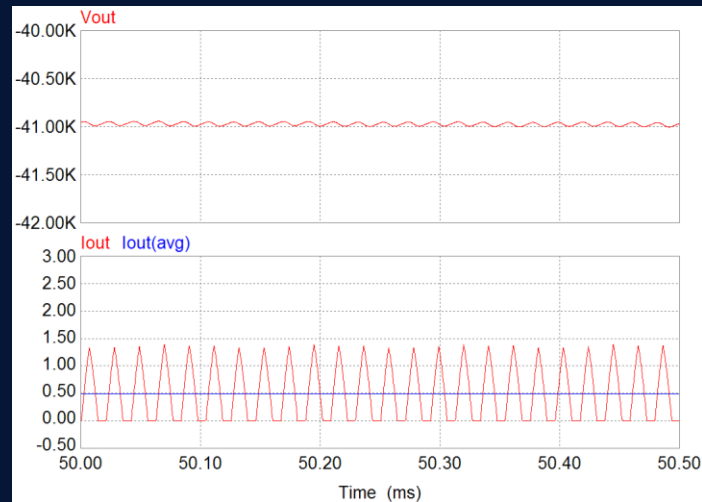
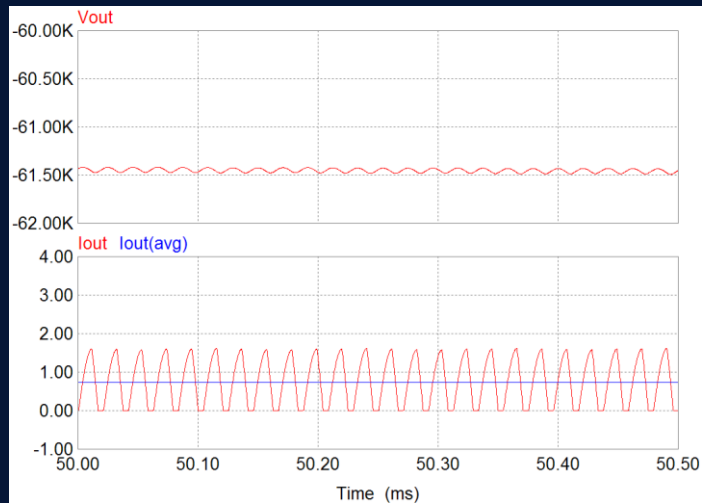


Rated output 83kV 1000mA

SMPS waveforms for different topologies

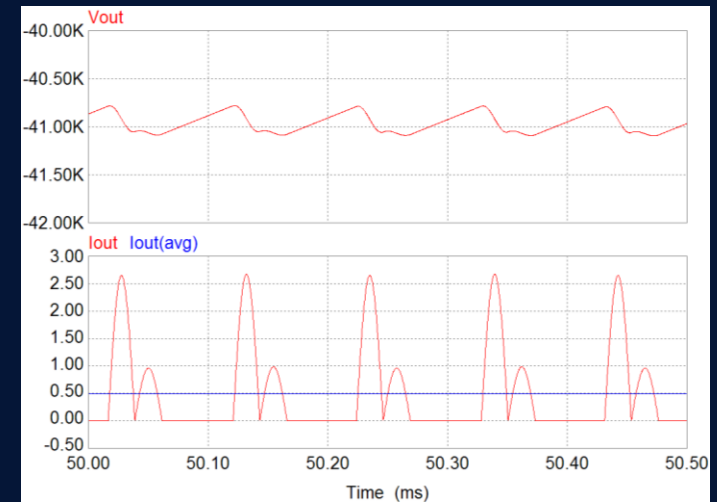
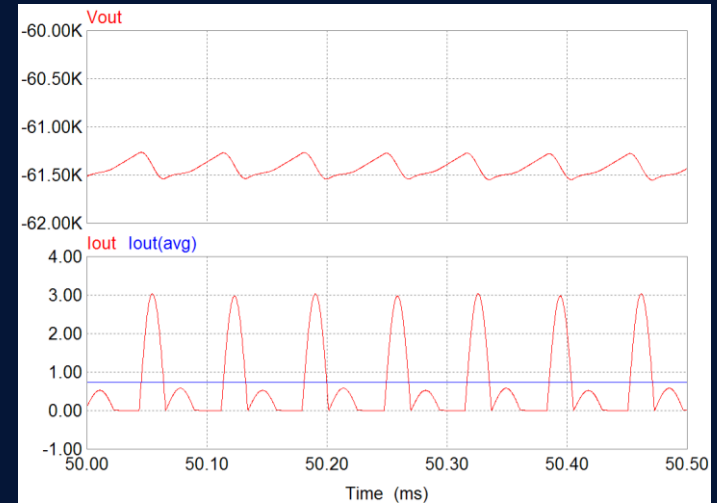
SmartKraft DC

Current limited to 75% and 50%



Competitor

Current limited to 75% and 50%

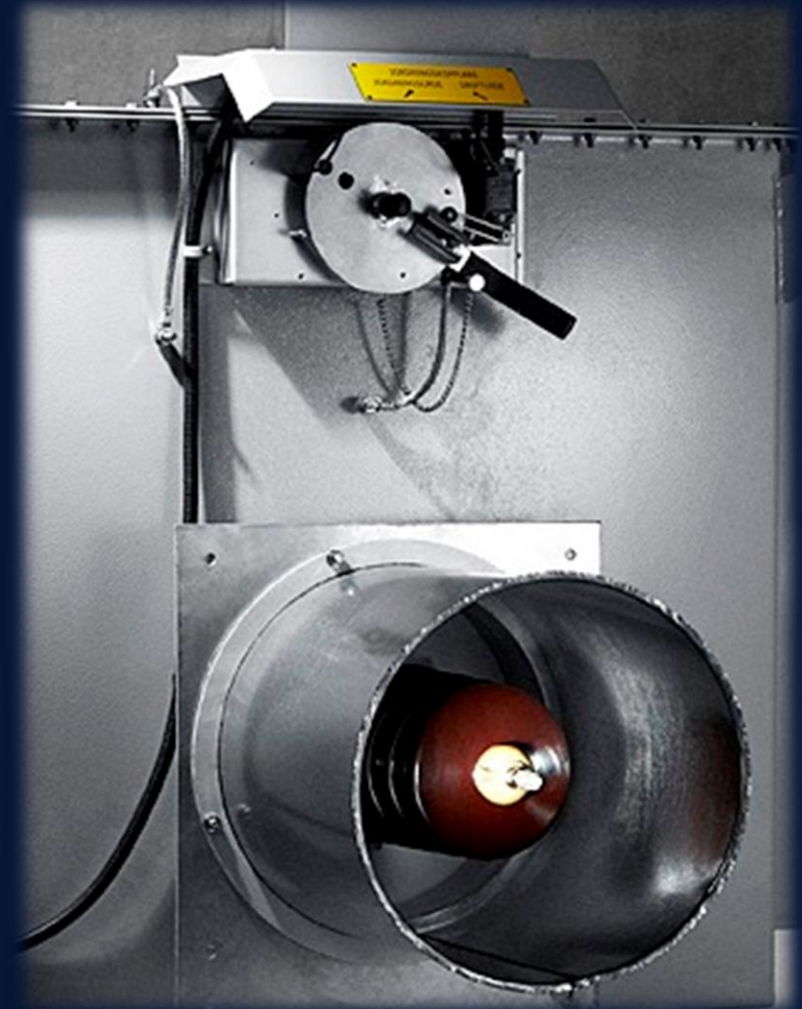


Safety

Internal switch connects TR to ground

Keystones

- In order to ground the power supply and/or the ESP
- Internal in the tank for difficult environments
- Possible to use limit switch and key interlock



Connect TR to ground externally

Keystones

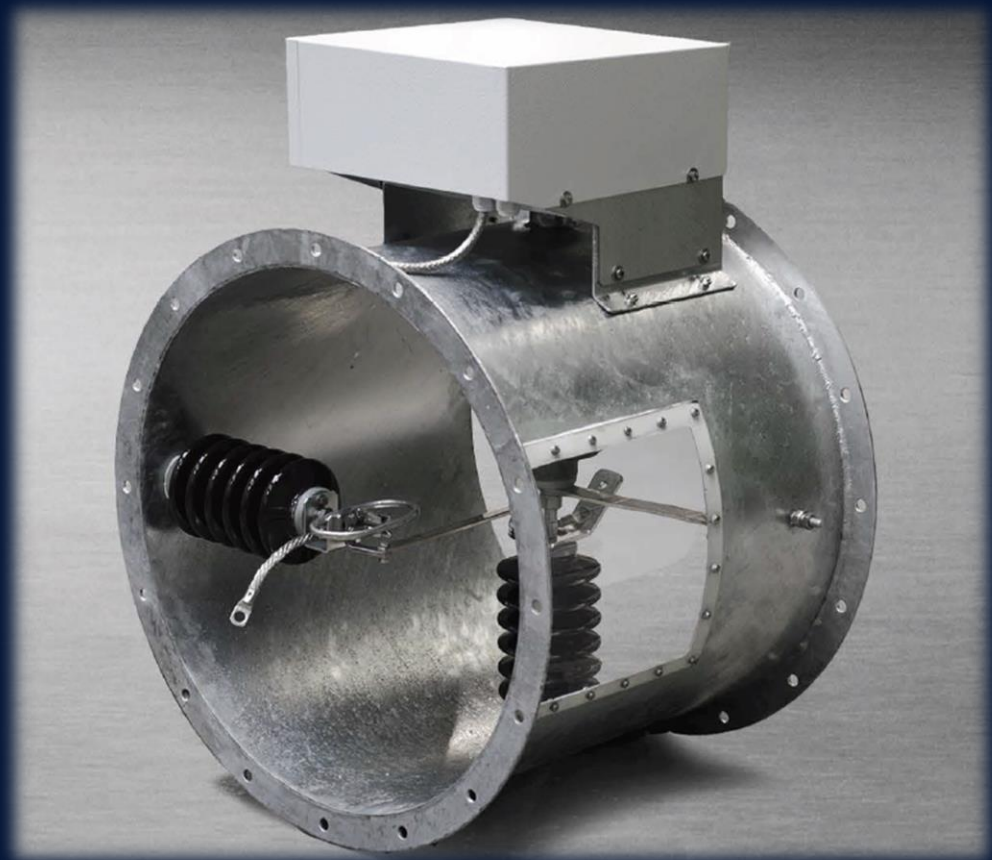
- For grounding the power supply and/or the ESP
- Limit switch and key interlock is possible



Automatic Grounding Switch AGS

Keystones

- For grounding the power supply and/or the ESP in less than one second
- Remote function
- Integrated Limit Switch
- IP54
- Wide working temperature range



Control

Next Generation of Advanced Controller of ESP Power supplies

NEW	SmartESP™: Automatic Control of ESP Power supplies parameters based on ESP performance	NEW	Remote monitoring via variety of communication protocols as well as Internet
NEW	All in one Hardware to control Single, three Phase or HF ESP power supplies	NEW	Support most of industrial communication protocols
NEW	VI Curve function	NEW	Datalogger function
NEW	Simple oscilloscope function	NEW	Export data, setting parameters and oscilloscope waveform to the USB flash memory
NEW	Bootloader and upgrade firmware via USB	NEW	SoftPLC/DAQ function. No limit of customized IO number.
	Intermittent Energization Mode "IE"		Individual program can be saved for different setting
	Spark Control		Support more than 14 languages per request
	Back Corona Control		CO and Voltage reduction
	Rapper Control		Opacity Control
	Control mode in both Voltage and Current		Auto-Restart function



MK4
2018-20XX



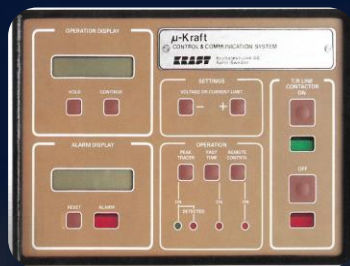
MK3
2005-2019



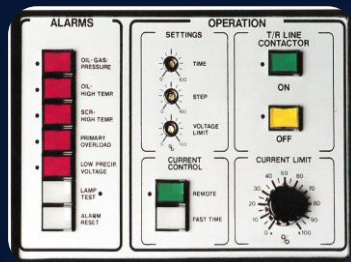
MK2
1990-2006



MK1
1988-1991



Analogue
1984-1989



MK2 / MK3 to MK4 retrofit Kit



Upgrade your existing Control Cabinet in no time

Short Delivery time and installation

Access to all MK4 features and values

NO need to change DCS/PLC program

Less cost and investment

Control Cubicles

Keystones

- ESP power supply control
- Control system communication
- ESP rapper & heating control
- Optional enclosure ratings
- Combine to one line, save space



NetKraft

keeps your ESP under smart control

From anywhere

- Cut investment cost
- Increase efficiency
- Prevent unplanned shutdown
- Better Performance
- Easy integrated to existing solution

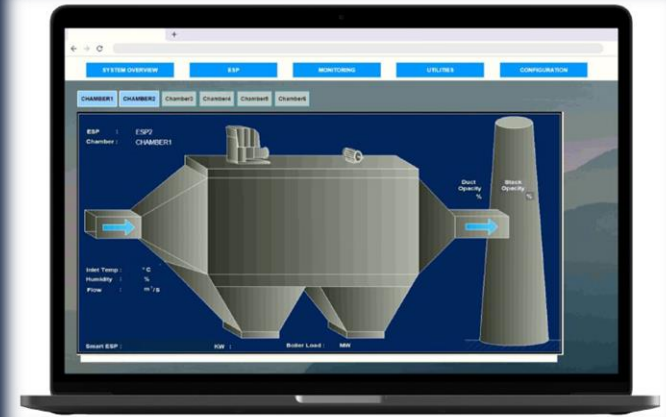


NetKraft

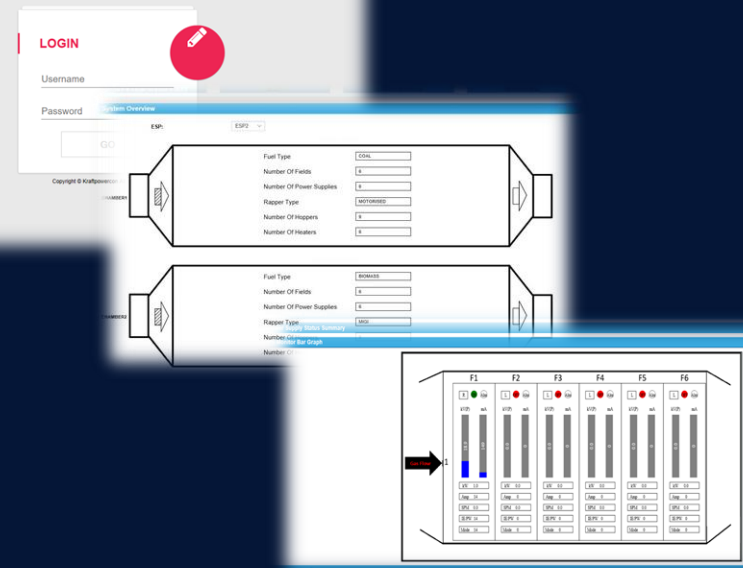
Is your ESP manament System

**KRAFT
POWERCON**
SINCE 1935

- Complete Control of ESP
- Support KP or customized Controller
- Web/LAN Server/Client Base
- Energy Management System
- Monitoring Features (data logger, trending/I curve, alarm handling, reporting and etc)
- Customized I/O configuration possibilities.



Welcome to NetKraft

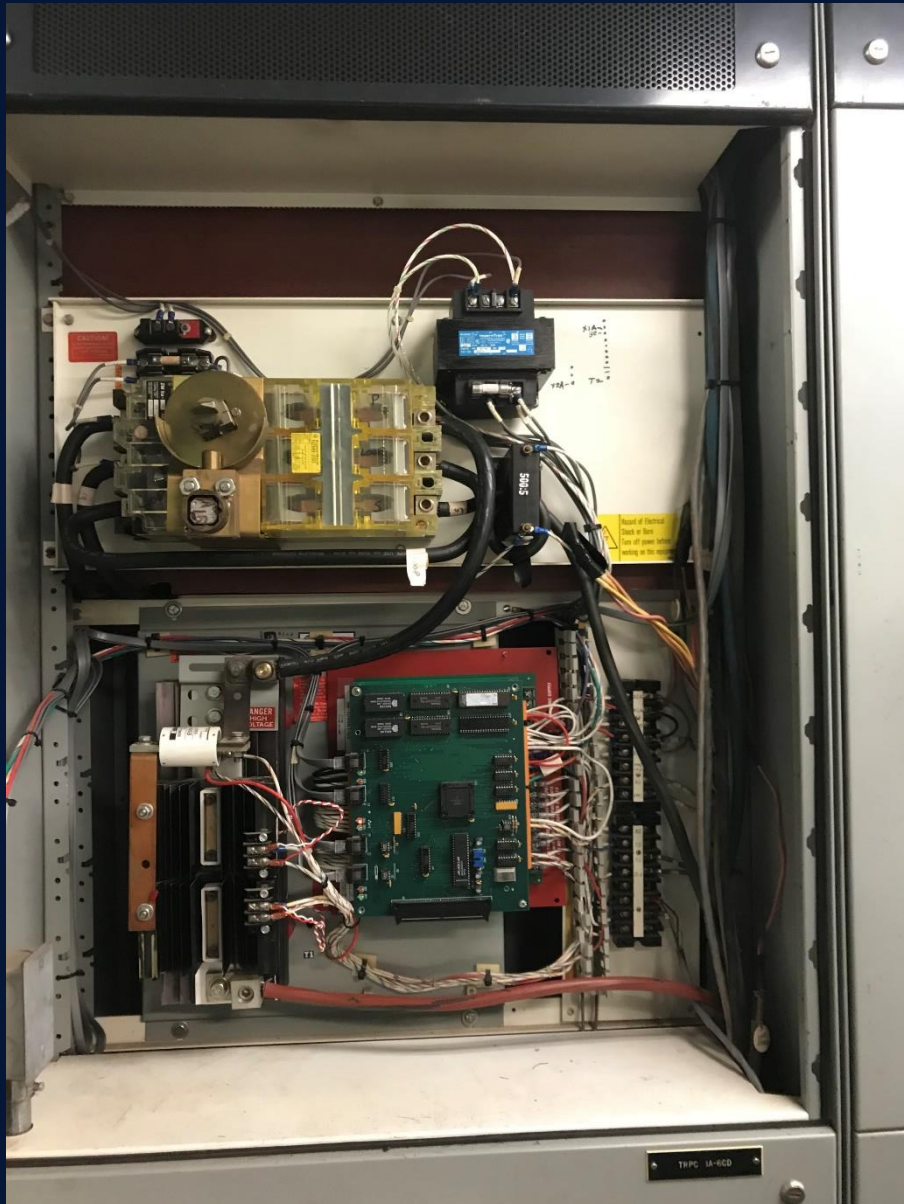


TR and Control Replacement Options

Single-Phase T/R Retrofit AEP Oklaunion



Controller Retrofit AEP Oklaunion



Case Studies

Project reference

KraftPowercon ESP upgrade solution

BIOMASS



Plant information

Plant Name Glefaran

Geographical Spain

Size 7MW

Fuel Biomass-Wood chips

Process Type

Initially in 1987 the precipitator was designed for a pulp mill, but today the process is the generation of electricity through a boiler burning forest biomass.

ESP information

Type Råkt

No of Chamber 1

No of Field 2

Age 1987



Before retrofit

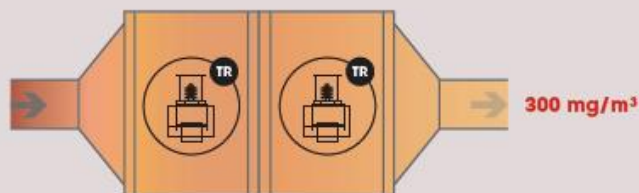
Type Single phase Transformer and control cabinet

Rating 70kV 400mA

Age 1987

MFG TR: Kraftelektronik, Controller: Alstom EPIC

Emission level Average more than **300 mg/m³**



PROJECT STEPS

1. Replace ESP electrodes
2. Replace rapper heads
3. To be sure there is no major failure in ESP shell and case.
4. Change both TR to SmartKraft™ on both fields

300 mg/m³ **Level**

150 mg/m³ **Target**

27 mg/m³ **Result**



↑ **UPGRADE**

SmartKraft+



Type **SmartKraft HFSMPS**

Rating **80kV 800mA**

Target Emission Level **Less than 150 mg/m³**

Final Emission Level **average less than 27 mg/m³**

Project time **from inspection till end of retrofit 5-6 weeks.**

Delivery of parts and TR less than 2 weeks.

Downtime **Less than a week**

Project date **April 2017**



COAL



Plant information

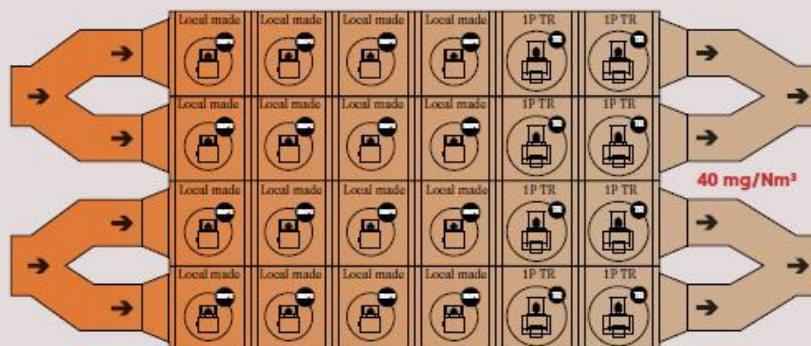
Plant name Huaneng Yimin Power Plant Boiler 2#
 Company Huaneng Power Group
 Website www.nmhdwz.com
 Geographical Yimin town, Neimenggu Province, China
 Size 500MW
 Process Type Coal Power Plant
 Fuel Coal

ESP information

Type Russian
 3ГД2-108-9-6-6
 No of ESP per boilers 3
 No of chambers 4
 No of fields 6
 Age 1998

Before retrofit

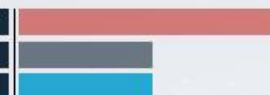
Type SMPS + Single phase
 Transformer and control cabinet
 Rating SMPS 72kV/1000mA, TR 60/1000
 Age 2014
 MFG China Longking
 Emission level 39.4 mg/m³



PROJECT STEPS

1. KP SMPS installed on first and second fields, the original Longking SMPS installed on 3rd and 4th fields, the original Longking single phase PSUs installed on fields 5th and 6th.
2. To be sure there is no major failure in ESP shell and case..

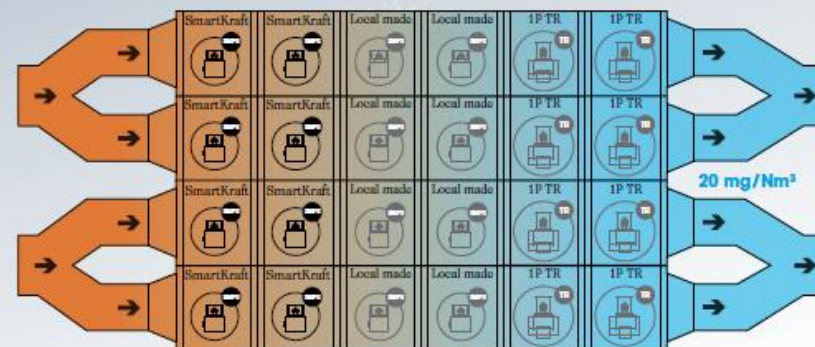
39.4 mg/Nm ³	Level
Below 20 Nm ³	Target
Below 20 Nm ³	Result



↑ UPGRADE



Type SmartKraft HF-SMPS
 Rating 80kV 1600mA
 Target Emission Level Less than 20 mg/m³
 Final Emission Level Average less than 20mg/m³
 Boiler shut down About 4 weeks
 Project date Dec-2017



Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.

www.kraftpowercon.com/esp

info@kraftpowercon.com

**KRAFT
POWERCON**

COAL



Plant information

Geographical Poland
Size 70MW

Process Type Coal Power plant

Fuel Combination of
90% Coal + 10% Biomass

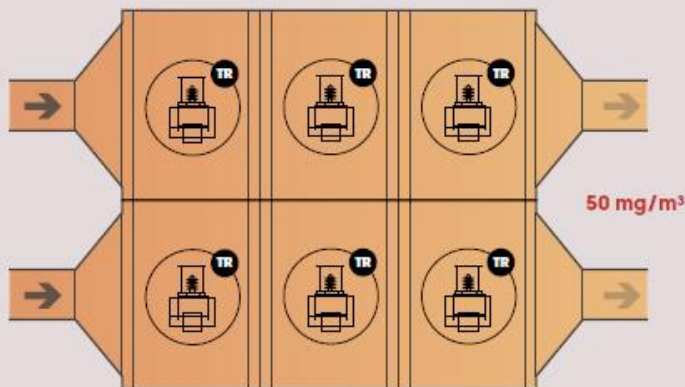
ESP information

No of Chamber 2
No of Field 3
Age over 25 years old



Before retrofit

Type Single phase Transformer and control cabinet
Rating 100kV 1100mA
Age 1987
Emission level Average 50 mg/m³



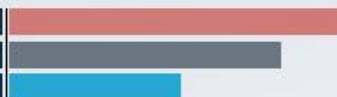
PROJECT STEPS

1. Normal maintenance of ESP
2. Change both TR to SmartKraft™ only in first field

50 mg/m³ Level

40 mg/m³ Target

25 mg/m³ Result



UPGRADE

SmartKraft



Type SmartKraft DC HF-SMPS
Rating 80kV 1600mA
Target Emission Level Less than 40 mg/m³
Final Emission Level Average less than 25mg/m³
Downtime Almost a week
Project date 2013



Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.

www.kraftpowercon.com/esp

info@kraftpowercon.com

**KRAFT
POWERCON**

PET COKE



Plant information

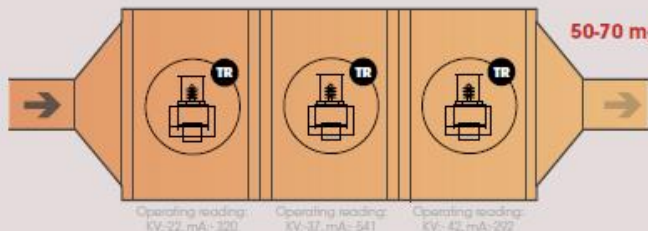
Plant name Rajshree Cement work
 Company Ultratech cement Limited
 Geographical India
 Size 235 TPH (Kiln load)
 Process Type Clinker Cooler ESP
 Fuel Pet coke

ESP information

Type Clinker Cooler ESP
 No of Chamber 1
 No of Field 3
 Age 1999 Approx.

Before retrofit

Type Single phase Transformer and control cabinet
 Rating 110 KV / 700 mA
 MFG TR: Ador, Controller: BHA make, Sq-300
 Emission level 50 to 70 Mg/Nm³



PROJECT STEPS

1. Change the existing single phase TR to Three phase TR.
2. Some mechanical damages were found and got it corrected under our supervision.



UPGRADE

Kraft Classic 3ph



Type **Three Phase TR set**
 Rating **95 KVP / 900 mA**
 Target Emission Level **Below 30 mg/Nm³**
 Final Emission Level **25 mg / Nm³**
 Project time **For supply of Three phase tr set it takes 8 weeks and 6 days for erection and commissioning**
 Downtime **Less than a 6 days**
 Project date **Jan-2017**



Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.

www.kraftpowercon.com/esp

info@kraftpowercon.com



PET COKE



Plant information

Plant name Ramco Cement R.R nagar
 Compnay Ramco Cements
 Website www.ramcocements.in
 Geographical Tamilnadu, India
 Size 75 TPH
 Process Type Clinker Cooler ESP
 Fuel Pet Coke

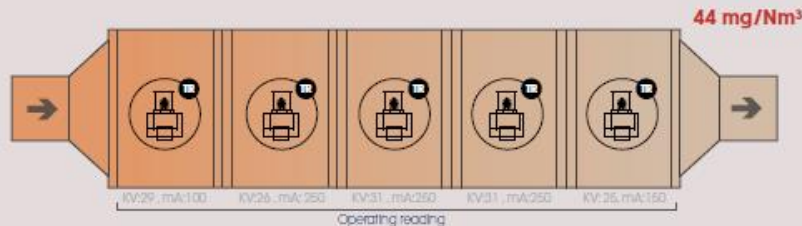
ESP information

Type Clinker Cooler ESP-2
 No of chambers 1
 No of fields 5
 Age 1993



Before retrofit

Type Single phase transformer and control cabinet
 Rating First & Second field: 90 KV / 600 mA
 Third, Forth and Fifth Filed: 70 KV / 300 mA
 MFG TR: Hirect
 Controller: NWL
 Emission level 44 mg/Nm³



PROJECT STEPS

1. Change the existing single phase TR to three phase TR

44 mg/Nm³ Level

Below 25 Nm³ Target

17.4 mg/Nm³ Result

UPGRADE

Kraft Classic



Type Three Phase TR set
 Rating 80 KVP / 600 mA
 Target Emission Level Below 25 mg/Nm³
 Final Emission Level 17.4 mg/Nm³
 Project time For supply of three phase tr set it takes 6 to 8 weeks and 3 days for erection and commossioning
 Downtime less than a 3 days
 Project date May 2017



Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.
www.kraftpowercon.com/esp
info@kraftpowercon.com





Thank you for your attention